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REPORT

ON THE

GEOLOGICAL AND AGRICULTURAL SURVEY

OF THE

STATE OF RHODE-ISLAND,

MADE UNDER A RESOLVE OF LEGISLATURE IN THE YEAR

1839.

BY CHARLES T. JACKSON, M. D.,

Member of the Geological Society of France; of the Imperial Mineralogical Society, St. Petersburg; of the Boston Soc. Nat. History, and Cor. Memb. Acad. Nat. Sciences of Philadelphia; Lyceum Nat. History, N. Y.; Albany Institute; Nat. Hist. Soc., Montreal; Providence Franklin Soc.; Prov. Nat. Hist. Soc.; American Academy of Arts and Sciences; Honorary Member of Maine Inst. Nat. Sciences; Geologist to the State of Maine.

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STATE OF RHODE-ISLAND AND PROVIDENCE PLANTATIONS,

In General Assembly, January Session, A. D. 1839.

Resolved, that the sum of two thousand dollars be appropriated and paid from the General Treasury, to defray the expenses of a Geological and Agricultural Survey of the State.

Resolved, that the same be expended under the direction of Messrs. King, Simmons, Potter, of South Kingstown, Rhodes, and Luther, with such as the Hon. Senate may add, who are hereby appointed a committee for that purpose; to serve without compensation: which committee are authorized to draw upon the treasury for such sum or sums as may be necessary, not exceeding in the whole, the aforesaid sum of two thousand dollars.

Resolved, that said committee be authorized to act in conjunction with any committee that may be appointed for the same purpose, by the Rhode-Island Society for the Encouragement of Domestic Industry.

House of Representatives, February 1. 1839.
Voted, &c. By order,
GEORGE RIVERS, Clerk.

In Senate, read February 2, and concurred, with the addition of Mr. King, of the Senate.

By Order,
HENRY BOWEN, Sec'ry.
True Copy—Witness,
HENRY BOWEN, Sec'ry.

In General Assembly, May Session, A. D. 1840.

The Committee appointed to procure a Geological and Agricultural Survey of the State, having accomplished the same, and having received from Doctor Charles T. Jackson, the Geological and Agricultural Surveyor, a satisfactory report:

Resolved, that the said Committee be and they are hereby authorized to cause one thousand copies of the Report of said Survey to be printed and bound: And that the said copies when finished be distributed in the following manner, viz: One copy to his Excellency the Governor; one to his Honor the Lieutenant-Governor; one to each of the present members of this General Assembly; one to the Supreme Executive of each of the United

States; one to the Town-Clerk of each town in this State; one to each School District in this State, excepting the districts in Newport and Providence; twenty copies to the town of Newport, and thirty copies to the city of Providence, which said copies shall be distributed in said Newport and Providence by the School Committees therein; one copy to each Public Library in the State; one to the Rhode-Island Historical Society; one to Brown University; five copies to the Library of Congress; and the residue to be deposited in the Secretary's office.

True Copy—Witness,

HENRY BOWEN, Sec'ry.

At a meeting of the Standing Committee of the Rhode-Island Society for the Encouragement of Domestic Industry, holden on the 26th day of December, A. D. 1838, the following resolution was adopted, viz:

Resolved, that Messrs. John Pitman, Joseph Mauran, Christopher Rhodes, and Owen Mason, be a Committee to memorialize the General Assembly, and to confer with such committee as the General Assembly may appoint, to inquire into the expediency of authorizing a Geological and Agricultural Survey of this State; and to adopt such other measures as they may deem expedient to carry the same into effect, and that the sum of five hundred dollars be appropriated by this Society, in aid of this object, provided the State shall, at the ensuing January Session, appropriate the residue of the sum necessary for the purpose, and take measures to carry the same into effect, under the immediate supervision of the State, or of this Society.

Attest, WILLIAM W. HOPPIN, Sec'ry.

To the General Committee, having in charge the Geological and Agricultural Survey of Rhode-Island:

GENTLEMEN,

I have the honor of presenting for your acceptance, a Report on the geology and agriculture of the State, in accordance with the contract made in April, 1839. This Report embodies all the facts which I have been able to collect during the year that I have been employed on the survey.

In presenting them for your consideration, I would remark, that a work so complicated and difficult, is not expected to be perfect, considering the short period of time allowed for its execution, and the immense number of researches that are required.

In the Geological department the difficulties are numerous, owing to the irregularities of the strata, and the obscurity produced by an almost universal covering of soils that conceal the rocks, so that only limited portions of them are exposed to view. The hills are comparatively of slight elevation, and are often covered with soil, to their very summits, exposing but a few naked rocks on their sides. Nevertheless, by a systematic comparison of localities, and by the lines of bearings and dip of strata, I have been able to represent the limits of each rock formation, with a considerable degree of accuracy, as will be seen on comparing the geological map and sections with nature.

The western portions of the State are very uniform and simple in their geological character, the primary stratified and unstratified rocks generally prevailing with great uniformity. Cumberland, on the contrary, is a very complicated geological district, insomuch that it is impossible to represent all its details on the small map accompanying this Report. The principal geological features are, however, correctly portrayed upon it, while many of the data that are not represented upon the map, are detailed in the Report.

A large portion of my time was devoted to an examination of the useful minerals and rocks; such as the various limestones, iron ores, quartz rock, building stones, and coal; while specimens of all the rocks of the State, with most of the curious and useful minerals, have been collected, examined, and described. A collection of three entire suites of the minerals and rocks have been arranged and labelled, and a catalogue of them is herewith presented. I have also collected 150 specimens of the soil, peat and swamp muck, from the different parts of the State, and having analyzed portions of them, have arranged the specimens in wide-mouthed six ounce glass bottles, all of which are labelled and numbered in order, with printed tickets.

The coal formation of Rhode-Island was also examined as minutely as it is possible, in its present state, and specimens of all the coals have been analyzed, and are herewith reported. Specimens of the fossil plants were also collected, and engravings on wood of a sufficient number of them to illustrate the subject have been executed by Mr. George T. Devereux, of Boston, who has performed the work in a faithful and artist-like manner. The same artist also prepared all the wood cuts that illustrate the text of the present Report.

In the agricultural department, I have done all that was possible, but owing to various circumstances it was found difficult to obtain statistical information from the farmers. Of the numerous printed blank farm reports that we have distributed, but six have been returned, and some of those are deficient in exactness.

Such information as I could glean among the farmers in my excursions, I have embodied in the report, and would remark that the matter is almost literally compiled from the field notes which I made at the time, it being considered of more importance to state the facts accurately, than to write in an ornate style. I have given all the contradictory opinions that prevail among the agriculturists just as they were stated to me, and have here and there given my own opinions on the subject in addition. The value of those opinions remains to be tested by experience, and I am satisfied that discussion upon the subject will result in much practical good.

The geological basis of the map, on which I have represented by colors the nature, extent, and limits of the rock formations, with the lines of bearing and dip of strata, was compiled from the most recent authorities, Stevens's map of the State, Nelson's survey of Cumberland, published by Aaron White, Esq., and the United States' survey of Narraganset Bay, having been reduced and corrected, where it was practicable, by consulting local authorities, or by a few measurements. Without pretending that the map is absolutely correct, it may be stated that it is sufficiently so for our present purpose.

The sectional profiles of the rocky strata were measured barometrically by nearly simultaneous observations at Providence and at the points in question. They are near approximations to nature.

In closing the present remarks, I would take occasion to acknowledge the able and faithful co-operation of my assistants and pupils, Messrs. John Chandler, Jr., of Augusta, Maine, and Moses B. Williams, of Roxbury, Mass., and the services rendered in the laboratory by Messrs. Henry Sumner, of Boston, and Ebenezer Baker, of Charlestown.

My special acknowledgements are due to Messrs. Samuel Austin, George G. King, Samuel Greene, and Professor Caswell, for the meteorological tables which they kindly prepared during the past summer, and I very much regret that in order to print this report in time to present it to the Legislature in June, it will be necessary to exclude those tables, and also the barometric tables, the preparation of which cost me no little time and labor. These, however, will be preserved, and may be published with a second edition if it should ever be necessary to publish a second. The catalogue of minerals, &c., must likewise be omitted, but manuscript copies will be furnished with the three suits of specimens.

I desire also to present my thanks to Messrs. Owen Mason, Welcome A. Greene, Moses B. Lockwood, and William Gilpin, for their valuable services in the survey. To the numerous citizens of Rhode-Island who have either aided me in my labors or have tendered to me their hospitality, I here present my grateful acknowledgements. I wish also to bear public testimony to the uniform kindness and zealous aid afforded me by gentlemen of the Committee, and beg leave to offer to them individually and collectively my thanks.

Respectfully, your obedient servant,

CHARLES T. JACKSON.

Providence, May 25, 1840.

INTRODUCTION.

A brief outline sketch of the great rock formations which are recognized by Geologists, may not be an irrelevant introduction to the present Report, since it will serve to aid those who have not studied the science, while engaged in the perusal of our observations on the geology of Rhode-Island. It will be impossible to present detailed descriptions of each variety of rock, or of the occasional minerals, in the few pages reserved for the present introductory remarks; but the characteristic features of each group will be portrayed with sufficient minuteness, to enable any one to recognize their distinctive features.

There are two methods of examining and describing the structure of the earth. The first is by commencing with the superficial deposits, and descending to the lowest known rocks; this method being denominated the descending order. Most of the modern English Geologists follow this order, in their descriptions of the structure of the British Isles. It has some advantages, and is at first view apparently a natural method. There are, however, many objections to it, which ought to be mentioned, since they are serious obstacles to its adoption. When we begin with the upper strata, which are generally of aqueous deposition, we find the detritus of which they are composed, originated from rocks situated lower down in the series, with which the learner is supposed to be unacquainted. The deposits are also described, as formed from, and subsiding upon, rock formations not previously described. Another very serious difficulty arises in teaching by this method, from the immense numbers and variety of organic remains, which are presented to the learner at his outset, and his attention is continually drawn off from the situation, and the structure of the deposit, to the consideration of the organic remains entombed in the strata, and to the analogies which they present with the present animated creation.

It must be evident to any one conversant with modern geological works, that they are frequently very deficient in correct mineralogical descriptions of the rocks, while great stress is laid upon the accidental fossils, which they contain. Zoological and Botanical characteristics are certainly of great value and importance, but they are not so decisive, respecting the age of a deposit, as the order of superposition of strata, and the mineralogical composition of the rock itself.

By following the ascending order, we begin with the lowest rocks known, and ascend to those which rest upon them.

This method is not only more simple, and clear, but is, in fact, the order which all students of Geology follow in learning the nature and relative situation of rocks. It is the true natural order, not only on this account, but also because it is the actual order in which the rocks themselves were formed.

A knowledge of the simple minerals which enter into the composition of rocks, is essential to the learner, and he should begin with those composing the oldest, or lowest in the series—namely, that group which is called Primary.

Lehman, a German, was the first geologist who remarked that this group of rocks occurred lowest in the series, and that they differed from the rocks reposing upon them, both in their mineralogical structure, and in being entirely destitute of fossil remains, of animals or plants.

He observed also, that the superincumbent rocks were made up of the fragments of those below them, and frequently contained remains of organized beings, such as marine shells or plants. Hence he styled the upper formation, Secondary.

At a later period, Werner recognized the intermediate or transition formation, and it was set off from the secondary as a deposit of greater geological age. The name signifies, that the world was at that time undergoing a transition from an uninhabitable to a habitable state; for this group of rocks contains the first traces of organized beings, such as Trilobites, (which are singular crustaceous animals whose genera are now wholly extinct,) and numerous marine shells, such as Producti, Spiriferæ, &c. It also indicates an intermediate deposit between the primary and secondary. This group rests upon the primary rocks, which have been elevated through their strata since their deposition.

Some geologists have attempted to abandon the name transition, and have proposed other names instead, but they have not been generally adopted. Others have proposed to group the transition and secondary together, under the name of Secondary, thus going back to the original plan of Lehman.

A numerical division, will doubtless be found preferable to any of those fanciful names, which have lately been proposed for certain groups of strata of the Transition series, and it is evident that the names Cambrian and Silurian, proposed for certain groups in England, will never be regarded in this country, as appropriate terms for our rocks; and I observe that they have not been adopted by De la Beche, in his late Report upon the Geology of Cornwall, Devon, and West Somerset.

A new nomenclature would be wholly irrelevant while Geology is in its present imperfect state, and it is highly desirable for us to maintain the old landmarks, until new ones can be established by general agreement. I therefore adhere to the name Transition, as originally applied.

The Secondary formation reposes upon the Transition, and sometimes covers the edges of their upturned strata.

This group is characterized by a great profusion of fossil remains of animals and plants, of marine, lacustrine, and terrestrial origin.

It contains numerous beds of bituminous coal, accompanied by an abundance of fossil plants, mostly of tropical origin ; such as various species of ferns, calamites, lepidodendræ, stigmariæ, and palm trees.

The Tertiary formation comprises those strata which rest upon the surface of the secondary, or contain the fossils characteristic of such a deposit. This group is very remarkable for the immense number and variety of fossils which it contains, and they are generally analogous to those which still occur in a living state.

The mineral ingredients constituting this deposit are argillaceous, calcareous, or silicious ; the nature of the sediment depending upon the rocks from which the detritus was worn, by the action of water. When marine shells abound, as they frequently do, they form a large portion of the mass, which is thus converted into a calcareous marl, or even into a solid rock, like limestone, such as that of Paris and Vienna. If argillaceous matter predominates, we have also beds of plastic clay, or of clay marl.

In England, France, and Germany, the Tertiary rests upon chalk, the upper member of the secondary formation ; but chalk does not occur in North America, but has as a geological equivalent, the secondary clay and marl, which have been clearly defined through the labors of our countrymen, Dr. Morton and Mr. Vanuxern of Philadelphia.

The Tertiary formations of New-Jersey, Maryland, Delaware, and Virginia, have also been described by Messrs. Rodgers and Ducatel.

Gay Head, Martha's Vineyard, presents a very characteristic locality upon the coast of Massachusetts, where this deposit may be studied.

Block-Island is the nearest approach to the Tertiary formation in Rhode-Island, but fossils are wanting, as they generally are throughout this formation in the State, so we do not know by the fossils, whether the group under consideration belongs to the same era with that at Gay Head, or not.

The region, colored yellow upon our map, is composed of regular strata of clay and sand, bearing frequently the appearance of ripple marks in its deposition. It underlays the diluvium, and was a tranquil deposit from water, immediately anterior to the last geological deluge. It then occupies the position of the newest Tertiary, and has all the usual characters, excepting in the want of fossil shells. Causes may have existed, which prevented the growth of such animals on this coast during the epoch of this deposit, and we wish only to lay down the fact as ascertained, that it is an antediluvian alluvium, or preceded the deposition of the diluvial boulders.

Description of the Primary and Metamorphic Classes of Rocks.

It is generally conceded by geologists, that the primary unstratified rocks were produced in the state of igneous fusion, from the oxidation of their elementary bases, attended by a violent heat, and that when they were elevated in that state against or through the superincumbent stratified rocks of aqueous deposition, mechanical displacement and chemical changes were effected in the latter class of rocks, at or near their junctions with the former. This result is proved analogically, by a comparison of the effects produced by those rocks, which are known to have been of igneous origin, and by reasoning on chemical principles we should have been able *a priori* to have predicted many of the changes in structure and composition, that are observed in the metamorphic rocks.

Thus we know, that when a mass of liquid volcanic lava cools very slowly, it will become largely crystalline, but if rapidly, it will form a slaggy or vitreous stone. If formed under pressure, it will be compact, and if it is ejected in the open air it becomes more or less porous. If thrown up in a melted state in contact with water, under little pressure, a pumice stone is formed. So also we remark that when masses of compact or stratified blue limestone are included in lavas, they become white and crystalline, and are very frequently rendered magnesian or become granular Dolomite, and if the rock was originally composed entirely of marine shells, we find that they have changed their form, are fused and crystallized into a granular limestone. Slates are semifused, and converted into jasper, or into chert. Sedimentary deposits are also rendered more or less crystalline. These are the known effects of volcanic fires, and many of them we are enabled to imitate by artificial means, in the laboratory. Thus Sir James Hall succeeded in melting pulverized chalk, into crystallized limestone, by heating it under pressure equal to a column of seventeen hundred feet of water, equal to about six hundred feet of liquid lava, and this grand experiment was thought of sufficient importance by the Huttonian Geological School in Edinburgh, to authorize a special embassy to the Wernerian School of Freyburg in Germany, to communicate the fact, since it removed one of the stumbling blocks in the way of the geological world and proved that the occurrence of lime in the state of a crystalline carbonate, in a rock, so far from disproving its igneous origin, was a strong proof of its having been subjected to the influence of fire, and this principle is now universally acknowledged by men of science.

When a greenstone trap rock, or a dyke of basalt is thrown up in contact with the red sandstone of Maine or Nova-Scotia, I have uniformly remarked that there were obvious signs of great chemical commotion, a perfect vescicular scoria always resulting, and the sandstone undergoes just such changes as we know would be produced by its fusion in contact with the intruded rock. If the sandstone contained an ore of copper, we find the copper has been melted, and it occurs in irregularly rounded lumps in the breccia or amygdaloid resulting from the interfusion of the two rocks, while not unfrequently we find crystals of metalic copper in the cavities. These facts concur with the testimony of Mr. H. T. De la Beche, that the fusing point of the trap rocks is near or a little above the melting point of copper; and I have ascertained in the crater of Vesuvius, by experiments on running streams of lava, that the temperature of liquid lava was at very nearly the same point.

I have also remarked in Maine and in numerous other places, that limestones composed of marine shells, when cut through by trap dykes, are changed, at point of contact, into crystallized limestone, identical with those varieties called primary, by the ancient Geologists. Professors De Beaumont, and Dufrenoy, Engineers of the Royal School of Mines of France, have also described in detail, a great number of similar facts, which may be observed among the Jura Alps and in Italy.

Mr. Von Buch, of Prussia, has also described similar phenomena in the Tyrol, and on the peninsula of Lugano in Venitian Lombardy. They all recognize these effects as the products of igneous fusion by the powerful heat of an erupted molten rock. De Beaumont in his "*Memoires pour Servir a une description Geologique de la France*," has described in detail and with great minuteness, exactly similar phenomena, as resulting from the upheaving of granite rocks, which have spread over the surface of the fossiliferous rocks of the Jura limestone group.

Such metamorphises may also be observed in this country, especially in the State of Maine, and in Nova Scotia, where rocks of igneous origin very frequently come in contact with those of aqueous deposition, and in Rhode-Island there are analogous phenomena, which indicate like causes.

However startling may be the assertion, it is nevertheless highly probable, if not indeed demonstrable, that all our Granite Mountains have been in a melted state, and that they were thrown up in the condition of a soft or plastic mass, like liquid lava, which by cooling slowly has become crystalline ; the integrant minerals segregating (or crystallizing by themselves,) in the process, so as to produce an aggregate of dissimilar crystals, which are united together by mere interlacement, and by the attraction of cohesion.

In order to conceive of such a state of things, the mind must accustom itself to an enlarged view of our planet, and take in a large mass, as if viewing it from a distance. Then we are no longer astonished at local and comparatively small groups of incandesent mountains, bursting through the superincumbent strata of aqueous deposition. We are not to look upon a mountain and compare its formation with the insignificant works of man, nor should we limit the power by a comparison with that within the reach of human beings, but nature should be compared with herself.

When we speak of the elevation of mountains, it is essential that our ideas should not be too limited, and that we should look rather to the uprise of a whole continent, than to the elevation of an insignificant hill. Thus we obtain a more adequate idea of the subject, and are enabled more easily to grasp and comprehend the whole phenomena. While minute and almost microscopic observation reveals to us the internal structure of the mass, and inspection of the little grains and crystals gives us an insight into the mode of action, or discovers to us the countless remains of plants and organic creatures entombed in the strata, which form the crust of earth, we fail without taking a more general view to comprehend the grandeur of the phenomena. It is like inspecting a fine painting with the microscope, by which we discern the kind of paints used by the artist, and how they are laid upon each other, while we should fail to perceive the effect and beauty of the design, unless we placed ourselves at a suitable distance, so as to take in the whole view in its proper light. It is thus we are to follow the views of those masters in geology, Von Buch, Humboldt, Cuvier, De Beaumont, the Brogniarts, De la Beche, Lyell, Murchison, Buckland, Mantell, Sedgwick, and other indefatigable observers in Europe, and apply the principles to the mass of materials collected by the industrious geologists now engaged in the exploration of eighteen of these United States.

It is probable that there may be new classifications proposed by the scientific men, now engaged in collecting facts, bearing upon this important subject, but none of those local appellations, which are so frequently put forth by geological writers, ought to be universally adopted until opportunities for a general discussion take place, which will ere long be effected by the union of the trans-atlantic geological societies and those of this country.

I therefore adhere to the original names of the great formations, such as Primary, Transition, Secondary, Tertiary, and Diluvial, interposing the term Metamorphic, to designate the alteration where there is evidence that rocks of igneous origin have changed the chemical or mechanical constitution of sedimentary rocks.

I shall also follow the ascending order in the geological description of the State.

Description of the Primary Rocks and their component Minerals.

Granite, gneiss, and mica slate, form the group, designated universally under the name of Primary rocks.

It is yet doubtful, as to the manner in which the two latter rocks were formed. Some consider them to have been originally suspended particles of granite, which subsided from water upon the granite rocks, and by the chemical action of that rock, were consolidated. Others suppose that the gneiss, if not indeed the mica slate, were produced by the rapid cooling of granite, when that rock was erupted beneath the ocean. There are arguments in favor of each of these opinions, which I shall not have time fully to discuss. If plumbago or graphite was produced, as many geologists believe, from the intense ignition of vegetable matter, the occurrence of that substance in the stratified primary rocks, would seem to indicate their sedimentary origin. Whatever disposition may be ultimately made of them, I, am disposed at present to regard gneiss, as the mere crust of rapidly cooled granite, such an origin being analogous to the separations observed in hornblende rock, in tabular basalt, and in modern lavas, besides being consistent with the process of separation of plates of metals and scorias, as effected by the chemist or metallurgist, when he dashes cold water upon their fluid mass. Mica slate has stronger claims to a metamorphic origin, for we observe all the stages of passage between that rock and the neighboring argillaceous slates, which contain most decided vestiges of organic remains of plants, belonging to the coal measures, and sometimes petrifications of marine shells and crustaceans, of the transition series.

Granite is a rock composed of aggregated crystals of the minerals quartz, felspar and mica, united together by mere interlacement and by the attraction of cohesion.

These minerals, it is supposed, segregated, or crystallized by themselves, during the gradual cooling of the mass. They cannot be accounted for upon any other theory, and no one now contends for the old Wernerian opinion, which attributed the formation of granite to crystallization from aqueous solution, an hypothesis utterly inconsistent with the known laws of chemistry.

Mr. De la Beche says that he has made many experiments on the degrees of heat required for the fusion of granites, and finds that they differ much from each other in that respect, " those containing the greatest quantity of mica without lithia being the most refractory, while those with lithia mica are far less so."

He found that the Cornish granite and elvans, were melted at a temperature about equal to that required for fusing malleable iron, those which contained the black non-lithia mica generally presenting that mineral unfused. " It is remarkable" (he adds) " that the granites and elvans all become vescicular when first melted, the cause of which is not ascertained."

It may be interesting to notice, as showing the different fusibility of the Cornish and Devon granites and Trappean rocks, that in these and other experiments he has found the latter to enter into fusion at or about the temperature at which copper melts. The difference in the heat required for melting these granitic and trappean rocks, is therefore considerable; for according to Daniel, the point of fusion of copper is at 1996° F., while the heat required for the fusion of malleable iron is the greatest which can be obtained in a smith's forge." We must however remark, that by the process of segregation of its constituents, granite becomes more difficult to melt than it was when first produced, and it is no paradox in chemistry, that nearly infusible minerals may be produced by fusing certain substances at so high a temperature, as to give such freedom of motion to the particles, that they may combine, to form an almost infusible substance.

This is not only the result of certain accidental operations in the manufacture of glass, but is the principle of a kind of pottery, invented by Count Rumford, who made a sort of almost infusible enamel, by heating glass for a long time to a very high degree.

So we observe in volcanoes, that by gradual cooling of the lava, crystals segregate which are vastly more difficult of fusing, than the lava from which they were formed.

Minerals entering into the Composition of Rocks.

Quartz is a glassy looking substance, which when pure undergoes no change by exposure simply to the heat of the blowpipe flame.

It crystallizes rarely in its primary form, which is a rhomboid, whose planes incline upon each other at angles of 94° 15′ and 85° 45′, but presents more frequently the secondary form of the six sided prism, with a six sided pyramid. Sometimes the two pyramids forming the terminations of the crystal approach so closely, as nearly to obliterate all traces of the prism, and a bi-pyramidal dodecaedron with Isosceles triangular planes results.

The crystals possess double refraction, with an attractive axis, and rotative polarization of light parallel to the axis.

The color of quartz varies with the accidental metallic oxides which it contains, or by admixture of other mineral matters.

Its specific gravity is 2.645, water being 1. It scratches glass strongly, and gives abundant sparks when struck with steel.

It becomes phosphorescent when two pieces of it are struck together, and a peculiar odour is perceived. By friction it becomes positively electric, but preserves its excitement for a short time.

Its composition is,

Oxigen	= 51.95
Silicium	48.05
	100.00

and is represented by the formula $(\overset{\cdots}{\mathbf{Si}})$

Beudant gives the results of the analysis of all the different varieties of this mineral, but the above being the description of a pure specimen, is the best type of the species. The variety of quartz most common in granite, is of a greyish or blueish color, having a greasy looking surface, like some varieties of impure flint glass. Common silicious sand is derived mainly from the soil formed by the disintegration of Granite containing this mineral.

Quartz is a very valuable substance, as it serves to form the basis of glass which is composed of this mineral melted with an alkali and oxide of lead, or in plate glass it is united with potash and lime. For this purpose granular quartz is generally preferred, and where it cannot be obtained, pure silicious sand is employed. When a very large proportion of potash enters into the composition of glass, the whole may be readily dissolved in boiling water, a soluble glass resulting.

On this principle chemists conduct the analysis of silicious minerals, and soils which do not yield to the action of acids before being attacked by an alkali, they being rendered soluble by fusion with potash or soda. Soluble glass is used in protecting wood from combustion, since the glass forming a crust on the fibre of the wood, prevents the contact of the atmosphere, so that combustion becomes impossible.

Silex enters into the composition of all plants, and forms the skeleton for the support of the sap vessels, and it also constitutes the entire epidermis, or external skin, of the stems of grasses and of all the cereal grains, but it is most abundant in the epidermis of rattans, bamboos, and reeds. The white substance found beneath peat bogs, and in swampy lands and ponds, so frequently mistaken for calcareous marl, is composed of the skeletons or shells of countless myriads of animalcules, in the state of hydrate of silica, or water and silex. Living animalcules have been discovered by Professor Bailey, whose skeletons or shells consist entirely of silex, and Mr. Owen Mason and myself have examined an infinity of them in the hydrate of silica. So that we find silex entering into the composition of inferior animalcules and the skeletons of plants.

The ashes of every kind of vegetable yields this substance, hence it is evidently essential to the growth or support of plants; and it is universally the basis of soils—none being without it. (See tables of analysis of soils.) Silex alone is entirely insoluble, but by its combination with other substances, it is rendered soluble in water. Potash, soda, and even the crenic acid, enable the water to take it up, and then it may be rendered capable of entering into the absorbent spongioles of vegetables.

In the mineral kingdom, silex is the predominant ingredient, and is found universally present in every rock formation; while it also is itself a mineralizer, or combines with many metallic oxides, to form silicates.

It is one of the most strongly electro-negative of the mineral substances, almost always playing the part of an acid, and combining with basic, or electro-positive substances.

Silicium, its radical or base, is a combustible substance, and oxidates when exposed to the action of air or water; hence, if it exists in its elementary state in the interior of our planet, it would with the other bases of the earths, tend to keep up volcanic fires.

Felspar is divided into two species, one being called Orthose and the other Albite. The former contains potash, and the latter soda; these alkalies being the characteristic chemical ingredients, which distinguish them.

Orthose is the most common species of Felspar, and it is found to be one of the regular constituent minerals of common granite. Its characters are as follows. The primary form of the crystal is a doubly oblique prism, whose angles are 120° and 60° on the sides, and the inclination of the planes on the base is 112° and 68°.

Its specific gravity is from 2.39 to 2.58.

It scratches glass, but may be scratched with the knife. It is anhydrous. When heated to whiteness before the blowpipe, it fuses into a white enamel.

A pure specimen of crystallized felspar, called Adularia, was analyzed by Berther, who obtained the following results:

Silex	= 64.20
Alumina	18.40
Potash	16.95
Lime traces	
	99.55

A specimen of red felspar from Lomnitz, analyzed by Rose, gave the following results :

Silex	=	66.75
Alumina		17.50
Potash		12.00
Lime		1.25
Oxide of Iron		0.75
		98.25

Its mineralogical formula is $3 \text{ A Si}^3 + \text{K Si}^3$ according to the calculations of Beudant.

Felspar undergoes a gradual decomposition, probably owing to the action of carbonic acid on the the alkali, which is converted into a carbonate, and is thus separated from the silicic acid, and alumina. It is also probable that the vegetable acids, formed by the decomposition of organic matter, serves to effect the decomposition of felspar, the alkali combining with the vegetable acid, and in that state it is readily taken up by the absorbent spongioles of living plants. Thus, by a slow and very regular decomposition, this mineral supplies the potash required for the growth of plants, and the forest trees, which are burned by man furnish from their ashes all the potash that is employed by him in the arts. No economical artificial process has yet been found out for the elimination of this alkali from felspar, and it is highly desirable that one should be discovered, since the destruction of the forests will ere long deprive mankind of this most important substance.

Felspar, in the state of fine decomposition or disintegration, is used in the manufacture of Porcelain, or China ware. It is readily prepared for this purpose by heating it red hot and plunging it into water and then grinding it to an impalpable powder, which becomes after remaining moist for some time a perfectly plastic white clay, that may be moulded into the forms desired, and then when baked glazed and burned, in the porcelain furnace, becomes that delicately translucent ware, so highly prized for its beauty. The same materials are also employed in the manufacture of mineral teeth, which are variously tempered by the addition of silex, and by the means of certain metallic oxides, are made by a skilful dentist to assume any tint required. There is at present, I believe, no establishment for the manufacture of porcelain in this country, the works formerly carried on, having, as I understand, given up the business. Felspar is, however, exported to England, from the State of Connecticut, it being obtained at Middletown in considerable quantities.

Albite or Cleavelandite crystallizes in the form of an oblique prism, the base being an oblique angled parallelogram, having three cleavages, whose angles are 118° and 62°—93° 30′ and 86° 30′—116° and 65°, the most brilliant of which is parallel with the base.

Sp. gr.=2.61. It scratches glass, but can be scratched with the knife. It is anhydrous, or contains no water. Before the blowpipe, it fuses into a white enamel. Its mineralogical formula, according to Beudant, is $3\,A\,Si^3+N\,Si^3$.

Cleavelandite from Chesterfield, Ms., by Stromeyer, gave

Silex	= 70.68
Al.	19.80
Soda	9.06
Lime	0.23
Ox. Mn. and Iron	0.11

Albite of Finland, analyzed by Tengstrom, gave

Silex	= 67.99
Al.	19.61
Soda	11.12
Lime	0.66
Oxide Mang.	0.47
Ox. Iron	0.23

It has not been particularly used in the arts.

Bendant includes in his description of Albite, another variety of Felspar, in which both alkalis are present. It is called Pericline, and is not an uncommon variety of Felspar. The following analysis of this mineral was made by Gmelin :

Silex	=	67.94
Alumina		18.93
Soda		9.98
Potash		2.41
Lime		0.15

MICA. This mineral is very easily recognized by its brilliant laminæ, which are easily split into thin leaves by the penknife, and are distinguished from talc by their elasticity, and the want of a greasy or soapy feel, which characterizes the latter mineral.

Mica may be split into plates not more than $\frac{1}{1000}$ of an inch in thickness. It is either colorless and transparent, or is tinged with various hues of green, red, or brown, by metallic oxides, which it frequently contains. Sometimes the green color is so intense as to give it a perfectly black appearance, unless thin scales only are viewed by transmitted light. Berzelius divides mica into three species, viz. :

1st. Mica with a Magnesian base.
2d. " " " Potash base.
3d. " " " Potash and Lithia base.

Much confusion appears yet to exist respecting the analysis and classification of the micas, it being evident that there are many different formulas of composition. It would take too much room to describe in detail every variety, and I shall content myself with the analyses, reported in Mr. H. T. De la Beche's Geological Report on the survey of Cornwall, Devon, and West Somerset. He states that the late Dr. Turner had made many analyses of micas, and gives, as examples, the two following common varieties from Cornwall.

	Brown Mica.	*Grey Mica.*
Silex =	40.06	50.82
Al.	22.90	21.33
Prot-ox. Iron	27.06	9.08
Prot-ox. Mn.	1.79	
Fluoric Acid	2.71	4.81
Potash	4.30	9.86
Lithia	2.00	4.05
	100.82	99.95

Mr. De la Beche calculates the composition of a granite consisting of "three-sixths felspar, two-sixths quartz, and one-sixth mica, would be as follows :

Silica =	73.04
Alumina	18.83
Potash	8.51
Magnesia	0.83
Lime	0.44
Ox. Iron	1.73
Ox. Manganese	0.10
Fluoric acid	0.18

And allowing two-fifths quartz, two-fifths felspar, and one-fifth mica, a very common kind of granite, we shall have,

Silex =	74.84
Al.	12.80
Potash	7.48
Magnesia	0.99
Lime	0.37
Ox. Iron	1.93
Ox. Manganese	0.12
Fluoric acid	0.21

To which a small proportion of lithia may be occasionally added, when the mica contains that alkali.

I have given the above analyses as terms of comparison, with the chemical composition of granite soils, which will be found to bear a striking resemblance to the composition of the rock itself, varying chiefly in the general absence of potash, and in an increased proportion of oxide of iron. It will be seen, also, by the tables, whence the granite soils derive the small proportion of lime which they contain.

It is easy by the mechanical separation of the minerals of granite, to ascertain their relative proportions, and by comparison with the above approximations, it will not be difficult to determine nearly their composition in a given case.

Granite is the proper type of an unstratified primary rock. It varies in appearance, with the relative proportions and disposition of its mineral ingredients. If it contain a large proportion of felspar it will be of a light color, but if there is a considerable proportion of dark colored mica, the granite will be dark. It will thus be observed that the mica is the shading material, in most of our granites.

Sienite may be regarded as a granite, in which hornblende takes the place of mica, and the quartz is less abundant than usual. Hornblende is a dark green or black substance, having a fibrous or longitudinally striated appearance, and may be distinguished from mica by its not splitting into scales when tried by means of the penknife. Its crystals have the form of oblique rhomboidal prisms, whose angles are 124° 30′ to 125° 40′. Its specific gravity is from 3 to 3.35. It scratches glass, and fuses before the blowpipe into a black glass. It is composed of the following ingredients according to Bonsdorf:

Hornblende of Pargas.		Do. of Vogelsberg.
Silex	45.69	42.24
Lime	13.83	12.24
Magnesia	18.79	13.74

Prot-oxide of Iron	7.32	14.59
Prot-ox. Manganese	0.22	0.37
Alumina	12.18	13.92
Fluoric Acid	1.50	traces.

He gives the formula $\mathrm{Ca\ Si^3+3\ (Mf\ )\ (Si^2\ A^x)}$ regarding the alumina as accidental and replacing the silex.

Gneiss, like granite, is composed of the minerals, quartz, felspar, and mica, and differs from granite only in its slaty or stratified structure, the laminæ of mica pointing in regularly uniform directions, so as to allow the rock to split easily into slabs. It is frequently compact and porphyrytic, with squares of felspar, which are thickly imbedded in its mass. It is a valuable stone for building, and for the construction of stone walls, as well as for paving the streets of cities.

This rock abounds in Rhode-Island, it being the predominant rock throughout the southern and western portions of the State. Some valuable quarries are wrought in this rock, and there are numerous other localities which may be advantageously opened whenever there may be a demand for building materials in their neighborhood.

Mica Slate is also one of the primary stratified rocks. It is highly valued for platforms, and is wrought in Connecticut and in Maine for flagging stones, which are used extensively in large cities for side-walks.

In Rhode-Island a variety of talco-micaceous slate is very extensively quarried, and furnishes an inexhaustible supply of sythe stones, which are exported for sale to other States.

Another rock belonging to this formation, also occurs in Rhode-Island, forming an extensive and elevated hill in Woonsocket, and extends from thence to Uxbridge, Mass., where it includes a small vein of highly argentiferous galena and black blende.

The rock to which I refer, is the granular quartz or fire stone of Woonsocket, a rock which contains only a sufficiency of talc and mica to give it the requisite strength for the hearths of furnaces. This rock is composed of rounded or irregular grains of quartz, united by the attraction of cohesion, and by thin plates of talc and mica. I have observed that after subjection to the intense heat of a smelting furnace, the mica fuses, and serves more firmly to connect the grains of quartz. It is so highly prized on account of its refractory nature, when exposed to intense heat, that it is sought for by all the furnace masters in the Atlantic States, and is used by them in preference to all other materials for hearth stones to their furnaces.

It may also prove to be suitable for the manufacture of glass ; and if upon trial it should be found to answer for that purpose, an establishment for the manufacture of plate glass for mirrors and large windows might be advantageously erected.

Hornblende Rock. This rock is composed chiefly of the minerals hornblende and felspar, with variable proportions of prot-oxide of iron, and occasional admixtures of iron pyrites and oxide of manganese. It is generally divided into irregularly angular blocks, which have their interstices filled with per-oxide of iron, or some other accidental mineral.

This rock occurs extensively in Rhode-Island, and presents some of the most perplexing geological enigmas that have fallen under my notice. It is generally regarded as an unstratified rock of igneous origin, but not unfrequently presents the appearance of regular stratification, or has a tabular structure. It passes frequently by imperceptible shades into chloritic and argillaceous slates, so that it is very difficult to define its exact limits, and to account for its origin.

After an extensive exploration of every portion of the State where this rock is seen, I am of opinion that it is decidedly a rock of igneous origin, like the greenstone trap rocks, and thus it belongs to the same geological group. I am of opinion that it derives its occcasionally stratiform structure from an admixture of argillaceous slate rock through which it was elevated, or that the hornblende rock has partially fused and assimilated the superincumbent slates. A similar rock occurs in Cornwall, in England, and De la Beche thinks it had such an origin; and it there presents the same slaty structure. The hornblende rock of Rhode-Island, occasionally passes into serpentine, and is associated with the talcose rock, commonly known in this country under the name of soapstone, and I am of opinion that the serpentine frequently is a product of the interfusion of the hornblende rock and the soapstone.

It is highly probable that by some unknown chemical process, the hornblende rock has charged the Smithfield limestone near its junction, with magnesia, and this accords with Mr. Von Buch's theory of dolomization.

The towns of Cumberland, Smithfield, and Johnston, present an immense tract of hornblende rock, which is an highly interesting and important formation, and will afford ample scope for study to all persons who wish to make researches in the higher branches of chemical geology. The hornblende rocks yield, by their decomposition, an admirable soil, warm and of good texture.

Talcose rock occurs only in beds included in other rocks, and is of comparatively limited extent. It is used for constructing the linings or interior of lime kilns, owing to its refractory nature, and it very fortunately occurs in the vicinity of the great limestone beds in this State.

This rock is composed chiefly of the mineral talc, the mass being made up of interlaced plates of the crystalline folia. It contains admixtures of magnesian carbonate of lime, brown spar, and hornblende crystals. Also regularly formed crystals of the bi-sulphuret of iron: all which are accidental, or non-essential minerals.

Talc, according to Berthier, is composed of the following ingredients:

Specimen from St. Bernard.		*Specimen from St. Gothard.*	
Silex =	58.2		62.
Magnesia	33.2		30.50
Prot-ox. Iron	4.6		2.50
Alumina traces		Potash	2.75
Water	3.5	Water and less	0.50

Klaproth.

Its formula is supposed to be, according to Beudant, $=M\ Si^3 + M\ Aq.$

Talc is soft, easily scratched by the finger nail, and is soapy to the feel. Its laminæ separate like those of mica, but do not possess any elasticity. It is infusible alone before the blowpipe. It is used sometimes to diminish the friction of machinery, and answers very well for that purpose, when free from silicious grit. Pure bright apple green talc occurs in Smithfield and Johnston.

Chlorite Slate is composed of the mineral chlorite, more or less mixed with other matters, such as hornblende, actynolite, and iron pyrites. It occurs abundantly in Rhode-Island, in Cumberland, Smithfield, and Johnston, and is invariably associated with the talcose rocks, and generally constitutes the walls of their beds.

Chlorite has, as its name signifies, a green color. It is composed of little shining scales interlaced with each other, having an arrangement like the grain seen in broken cast iron. It is soft and sectile, so that it may be easily cut with the knife, and large and compact masses may be turned in a lathe into vases and boxes, that would be mistaken for bronze. It was from this mineral that the aboriginal inhabitants of this vicinity used to carve their calumets: and in Maine, the Indians to this day make annual visits to the chlorite beds for the purpose of obtaining stone for making pipes. It withstands admirably the action of a moderate fire, and was even used by the Indians for making pots, which they used in cooking food.

Chlorite is composed, according to the analysis of Berthier, of

Silex	=	26.8
Alumina		19.6
Prot-oxide of Iron		23.5
Magnesia		14.3
Potash		2.7
Water		11.4

and the formula, according to Beudant, is$=2\ A\ Si + (M.\ K.\ f\ )\ ^{2}Si + 2\ Aq.$

LIMESTONE. This is perhaps one of the most important rocks used by man, and he owes to it many of the conveniences of life. Without it we never could have known the comforts of a well built, safe, and warm house, and no substantial cities could ever have been constructed.

It is essential not only in architecture and the various arts, but is also an indispensable substance to the skilful agriculturist, who by its proper use, in combinations with other materials, can ameliorate his soils. In this view it deserves our careful consideration, and it will receive a more detailed examination in the body of the present report. Suffice it now to say, that no soil is ever to be ranked as fertile, unless it contains a certain amount of calcareous matter.

Limestone, when pure, is a carbonate of lime, consisting wholly of carbonic acid and lime without any admixture; but it rarely happens that it is free from all foreign matters. Crystallized limestone or calcareous spar, in its purest form, is known under the name of Iceland spar. It possesses double refraction, and hence is sometimes called double refracting spar. It crystallizes in its primary form, which is a rhomboid, whose angles are 105° 5′ and 74° 55′, and it also presents an infinity of secondary forms, derived from its primary. Its specific gravity is = 2.7231.

When a crystal of it is pressed between the fingers it becomes strongly electric, and remains in an excited state for a considerable time, so that, if insulated, it will serve for an electrometer. Those varieties which are free from metallic matters, phosphoresce when thrown on a plate of iron heated below redness, and give out a golden yellow light of great brilliancy.

Its double refracting properties are strongly marked, and it has one repulsive axis of double refraction. This property, so long considered merely a curiosity, is now employed in the construction of micrometic telescopes, by which distances of objects of known size, can be determined with great precision.

Carbonate of lime may be distinguished by pouring upon it some muriatic acid, when a rapid effervescence due to the escape of carbonic acid gas, will take place, and the solution when neutralized will give a white precipitate with the oxalate of ammonia.

When a piece of carbonate of lime is exposed to a full red heat, it loses its carbonic acid, and is converted into quick lime, which when moistened with water will slake into a hydrate of lime.

Iceland spar is composed of the following proportions, according to the analysis of Stromeyer :

Carbonic acid	43.70
Lime	56.15
Prot-oxide of Mangenese and a trace of Iron	0.15

Its mineralogical formula is $Ca\,C^2$.

In the tabular view annexed to this Report, will be found the results of my analyses of all the Limestone of Rhode-Island.

There are many varieties of limestone in the State, some of which are remarkably pure, and others are mixed with variable proportions of foreign matters, or form new combinations with magnesian or manganesian isomorphous carbonates.

Among these varieties, is that kind of magnesian limestone which has been named in honor of the distinguished French Geologist, Dolomieu, and is called Dolomite. This mineral, when pure and crystallized, presents the primary form, which is a rhomboid, having the angles of 106° 15′, and 73° 45′, and also exhibits numerous secondary forms derived from its primary. Its specific gravity is 2.859 to 2.878.

It is harder than calcareous spar, which it scratches. It is not so readily rendered electric as the calcareous spar. It dissolves slowly without much effervescence in cold nitric acid. It is composed of variable proportions of carbonate of lime and carbonate of magnesia, but the present form here described has for its formula $= \mathrm{Ca\,C^2 + M\,C^2}$.

A specimen from Mexico analyzed by Beudant, gave

Carbonate acid	=	47.
Lime		30.4
Magnesia		21.5
Prot-ox. Iron		0.9
		99.8

I have analyzed a great number of specimens of this species of limestone, and find in all of them a small quantity of carbonate of manganese, in addition to the carbonate of magnesia.

These substances being isomorphous, or having particles of similar form, easily replace each other, and hence the number of varieties which are found in nature. (See annexed tables of limestones.)

The magnesian limes of Rhode-Island have always ranked high in the estimation of masons, and they are prized for the quickness of their setting when converted into mortar, as also for the beautiful whiteness of the lime. Hence the Smithfield "hard jointer" rock, being a magnesian limestone, makes a variety of lime that commands a higher price in the market than any other.

This kind of lime is however unfit for agriculture, and care should be taken to use only the soft rock for that purpose, since it is free from magnesia. It is owing probably to the employment of the magnesian variety that the use of lime has not met with better success in this State, and where I have made inquiry into the causes of failure either in Massachusetts or Rhode-Island, I have frequently learned that magnesian lime had been employed.

In England they have such an abundance of this rock, that they have endeavored to make use of it, and have in some measure succeeded by composting it for a season with fermenting vegetable matters, so as to saturate the magnesia with carbonic acid gas, and thus render it inert; but it is essential that in the beginning of a new practice in Rhode-Island, that lime free from magnesia should be employed, and it can be obtained in any desired quantity from the soft rocks of Smithfield.

The Dolomite in Rhode-Island is that portion of the bed which comes in contact or near to the hornblende rock. In some instances, however, the line of dolomization appeared to terminate abruptly, at the distance of six or ten feet from the hornblende rock.

In the harbor of Newport there are two islands of yellow compact limestone, which are highly magnesian and manganesian, and possess some hydraulic properties, so that the cement made of it was found to be very durable, it having withstood the ravages of time in some old walls longer than the bricks and stones themselves. It has been used in the construction of Fort Adams by that skilful officer and engineer, Colonel Totten, of the United States Army.

Geologists are of opinion that a large proportion of the limestones were formed from corals and the remains of shell fish, and this belief is rapidly gaining ground among men of science. If the Rhode-Island limestones were produced from such materials, they must have been most effectually fused, since no traces of organic structure can any where be found. It is not, however, more improbable than the ascertained fact that the Carrara marble had such an origin.

The Transition rocks repose upon the Primary, and are composed chiefly of their detritus, including also the remains of crustacean animals, shells, marine and land plants.

Clay slate is a deposit of fine particles of argillaceous and silicious matter, from mechanical suspension in water, and its deposition indicates a tranquil period ; for the process must evidently have been very slow, since time was allowed for each stratum to become inhabited by marine animals, or deposits of plants, before the next layer was super-added.

In Rhode-Island the clay slate instead of being filled, as it usually is, with fossil trilobites and marine shells, contains an immense number and variety of cryptogamous and cellular plants, such as numerous species of ferns, stigmariæ, calamites, asterophyllites, &c., which are the usual indications of the coal bearing strata, and in this deposit occur all the beds of anthracite which are found in Rhode-Island and Massachusetts.

From the fossil contents of the carboniferous clay slate, we have reason to regard it as a fresh water deposit, either from lakes or from the estuary of some ancient river, whose waters may have brought down from the low lands on its banks an abundance of these specimens of the ancient flora. The most surprising fact connected with such a deposit, is generally considered that these plants are analogous to genera now growing only within the tropics, and that all the species are extinct. (See Brogniart's Vegetable Fossils.) The coal plants of Rhode-Island have a remarkable resemblance to those found in the anthracite regions of Pennsylvania, and some of them resemble closely those which occur in the bituminous coal mines of Nova Scotia, New-Brunswick, England, and France. The species called Pecopteris Serlii is thus found in each of the above named deposits, and is also found in the mines of Mansfield, Mass. and Portsmouth, Rhode-Island, and also in Bristol and on Warwick Neck. Hence the vegetation of this ancient period in Rhode-Island was nearly identical with that which prevailed during the more recent or higher deposits of the bituminous coal field. (See plates of fossil plants at the end of the present report.)

The carboniferous clay slate is always found associated with another rock, which more frequently occupies a higher place in the deposit. It is a rock that was named by the German geologists Grau-Wacke, a name about which there is much cavilling at the present day, on account of its harsh sound, but no better one has yet been found for a substitute. The fine grau-wacke consists of small grains of the primary rocks, more or less rounded, and cemented together into a solid rock, by the fine particles of argillaceous matter, derived from the same source. Higher up we come to a coarse conglomerate which consists of rounded and smooth pebbles of the granite, sienite, hornblende, and quartz rock, flinty slate, jasper, and compact felspar, the three latter being apparently mere metamorphoses of the slate rocks, effected by fire. All these pebbles bear the most evident marks of long continued attrition, their forms being rounded, or more frequently oval, and their surfaces polished by friction upon each other;

they having doubtless been rolled for a long time by currents of water, or the surges of the ocean. From the manner in which the pebbles are situated, the long axes of the oval shaped pebbles generally coinciding, it would appear that there was a certain uniformity in the direction of the currents, that ground their surfaces against each other, or if we suppose they were rounded by the action of the surf, we can easily form some idea of the direction of the line of coast at that epoch.

One of the most remarkable localities to which I would refer, is that called Purgatory, near Newport, where may be seen a conglomerate made up almost exclusively of blue quartz pebbles of an oval shape, ground smooth on their surfaces, and all the axes of the pebbles coinciding in direction. Miantonomah Hill, near Newport, also exhibits the coarse conglomerate resting upon the finer kind, and that again upon the blue clay slate. Other instances may be observed near Providence, and all along the road from thence to Roxbury, Mass.

After examining the grau-wacke group with great care, I have not been able to find any other organic remains, than those belonging to the vegetable kingdom. From the fossils alone, a geologist would class the grau-wacke rocks of Rhode-Island with the secondary formations, and make them identical with the bituminous coal measures of England ; but it will be difficult for any one who examines the order of superposition, and the structure and composition of the rocks themselves, to support such an opinion.

The grau-wacke rocks, with their subordinate slates, fill a deep gorge or valley in the primary rocks, which border this deposit. The. long axis of this eliptical basin runs nearly north and south, and it is narrower in an east and west direction. From the angles of the dip we may form an approximate idea of the depth of the deposit, and we find that a curve nearly coinciding with the dip which forms its tangent, will give in the widest part of the basin two and a half miles for its greatest depth, and about one mile in its narrower portions. It is not probable, however, that this deposit has really so great a depth, for the strata are probably more highly inclined on its borders, they having been elevated since the deposition of the grauwacke rocks. I should therefore not believe the whole depth of the transition formation in Rhode-Island would surpass one mile in the widest portions of the basin.

By inspecting the Geological Map and Sections accompanying this Report, it will be seen how this basin is formed, and the strata on its margin will be noted as dipping towards its centre. The termination of the north extremity of the basin is near Boston, while it reaches to East-Greenwich and Newport on the south, and embraces both sides of Narraganset Bay and Providence River.

At the junction of the slates and granite rocks, various remarkable metamorphises are seen ; and the clay slate is either converted into mica slate, flinty slate, or even into a scoria filled with epidote, as may be seen on Newport Neck.

No secondary rock formations are recognized in Rhode-Island, but we find an ancient alluvium or aqueous deposit that took place anterior to the diluvium or stratum of the transported boulders, and is classed as a tertiary deposit, although no marine shells, characteristic of that formation, have yet been discovered.

The same deposit exists extensively in Massachusetts, and was described as the newest tertiary by Professor Hitchcock, in his Report. It is composed of plastic clay and sand, often alternating with each other in regular and wavy strata, which are nearly horizontal. The brick clay belongs to this deposit, and it exists abundantly at Block-Island, forming cliffs sixty or more feet high, and it also appears on the shores of Seekonk River.

There are some clays of the tertiary formation highly charged with marine shells, so as to become argillaceous marls, such deposits being abundant in New-Jersey, and in Maine, but they are wanting in Rhode-Island and Massachusetts, excepting at Gay Head, where there is a tertiary clay containing many fossil shells, and sharks' teeth, besides lignite or carbonized wood, which was formerly mistaken for coal. Amber is said to have been found there also, but it is rare. The tertiary formation in Europe is divided into three epochs. 1 Eocene. 2 Miocene. 3 Pliocene. And each is characterized by its relative proportions of recent and extinct species of shells. But since shells are not found in the tertiary of Rhode-Island, it will be unnecessary for me to describe the usual characteristic fossils in detail.

Diluvium. In every portion of the northern hemisphere, that has been examined by geologists, indubitable proofs have been discovered of a great deluge of waters, which came from the north and rushed southwardly, bearing forward in its course immense quantities of such loose materials as it encountered, and depositing them far to the south of their original localities.

By this grand *debacle*, not only soils were removed from the surface of their native rocks and deposited upon others far to the southward, but large blocks of stone were also removed in a similar direction to great distances, and they have engraved grooves and scratches upon the surface of ledges over which they passed so as to indicate the exact course of the current, while by following the direction of these marks to the northward, we are sure to discover the parent rock in place, from which these erratic blocks were torn. Thus in Russia, near St. Petersburgh, boulders of granite peculiar to Norway and Finland, are discovered in great abundance, while no such rock occurs in the immediate vicinity. In Massachusetts and Maine similar phenomena are discovered in almost every portion of those States, the cases being so numerous that it would require a volume to detail them. (See the Reports upon the Geology of Massachusetts, by Professor Hitchcock, and those upon the Geology of Maine.)

Professor De Beaumont, of Paris, informs me that the subject of diluvium is now exciting great interest on the continent of Europe, and that observations like those detailed in the above Reports, have been made by himself among the Jura Mountains; he has also received similar accounts from Professor Berzilius, of Sweden, with specimens of the diluvial furrows upon rocks from that country.

Rhode-Island presents some very decisive facts upon this subject, which are beyond all dispute, and will satisfy any one who examines them however incredulous he may have been previously.

I was long since informed by Mr. Owen Mason, that he had traced the boulders of porphyrytic iron ore, (which occur scattered profusely around Providence and upon the island of Rhode-Island,) to their native bed in Cumberland, and I have since not only seen all the instances quoted by him, but have been able in my excursions to point out numerous other characteristic examples of similar phenomena, and have taken the exact bearings of an infinity of diluvial scratches in various portions of the State.

There cannot remain a doubt that a violent current of water has rushed over the surface of this State since the elevation and consolidation of all the rocks, and subsequent to the deposition of the tertiary clay, and that this current came from the north. Were there no other evidence than that of the displacement of the Cumberland iron ore, the instance is so decisive, that it would be difficult to avoid the conclusions to which we have arrived, for that kind of iron ore exists in place no where in New-England, excepting at the Iron Mine Hill, in Cumberland; and is so very distinctly marked that no one who has ever seen it could possibly mistake its character.

We find also that the size and numbers of these boulders decrease as we trace them southwardly. Those at Providence, on the side of Prospect Hill, being two or three feet in diameter, while at Pappoosesquaw's Neck they are not more than eight or ten inches, and at the southern extremity of the island of Rhode-Island, they are rarely larger than ordinary cannon balls, from four to twelve pounds weight. So on Warwick Neck we find the same kind of boulders, the largest being about a foot in diameter.

The width of the line of deposition of these diluvial boulders, was about eight or ten miles, and beyond these limits none of the Cumberland iron ore is found, nor do the boulders occur at all to the northward of the Iron Mine Hill, while they are so abundant to the southward of it that the fences to most of the fields are constructed of them, they being profusely scattered in the soil.

Upon the surfaces of solid ledges, wherever they have been recently uncovered of their soil, scratches are seen running north and south, and the hard rocks are more or less polished by the currents of water which at the diluvial epoch coursed over their surfaces, carrying along the pebbles and sand which effected this abrasion, leaving striæ, all of which run north and south, deviating a few degrees occasionally with the changes of direction given to the current by obstacles in its way. The magnetic direction of most of the scratches which I have measured by the compass is N. 5° E., S. 5° W., and the variation of the compass is about 7° 30′ W., so that the direction of the scratches will vary but a few degrees from the true meridianal line, and this is the course in which this ancient current moved.

In the body of the present Report will be found examples of diluvial phenomena which were collected while engaged in the present survey, and any person will be able by visiting the localities to familiarize himself with the facts here recorded.

Various theories of the origin of the geological deluge have been proposed, the majority of writers endeavoring to identify it with the Noachan flood described in sacred history ; while others maintain that there is no geological proof of the existence of man upon the earth anterior to this event, no traces of his works or remains ever having been discovered in the tertiary deposits which preceded the geological deluge.

It must be remarked, however, that the continent of Asia, the supposed birth place of man, has not yet been explored by geologists, and it cannot yet be certainly known whether man was created anterior or subsequent to this event. There is one geological fact which seems to prove that the world was habitable to the human race at the tertiary epoch, and that is the occurrence of remains of mamalia, birds, and other animals requiring a similar condition of things for their existence. So that no physical obstacles appear to have unfitted the world for his residence at that epoch.

The causes which produced the rush of the waters from the northern seas over the surface of the land, are not yet known, although the fact is beyond a reasonable doubt.

By change of the earth's axis of rotation, and of its inclination to the ecliptic, if effected in a sudden manner, we might be able to account for the phenomena, and the elevation of a new continent, (eg. South-America,) would create a sufficient disturbance of the earth's equillibrium to effect such a change by the laws of gravitation and impulse. Diluvial phenomena must be more generally examined before we venture to give credence to any hypothesis, and I merely throw out the above suggestion in order that the facts may be examined in relation to it in various portions of the globe. The course of the diluvial current is a subject of vast practical importance, since by knowing its direction and force we may trace back loose masses of valuable minerals to their native veins and beds, this having been done by geologists successfully in many instances.

The distribution of soils effected by such a current is also a subject worthy the attention of every enlightened agriculturist, not only on account of the scientific interest which the facts would naturally kindle, but also in a practical light, for he may thus account for the peculiarities of certain districts and may be enabled to select arable soils for cultivation, with a more correct judgment. I shall have occasion to present some other considerations in the remarks on agricultural geology, and the tables of analysis of soils will give numerous instructive examples of the commingling of soils by diluvial agency.

REPORT.

GEOLOGICAL AND AGRICULTURAL SURVEY OF THE STATE OF RHODE-ISLAND.

In accordance with an agreement made with the General Committee on the Geological and Agricultural Survey, I entered upon the work assigned me on the first of May, 1839.

In a single season it was not expected that I should be able to effect more than a general reconnoisance of the State, and to point out the most important of its Geological and Agricultural resources.

Enough, however, has been done to throw some light on this subject, which will doubtless contribute towards the general improvement of the Arts which are dependent upon the substances found in the earth. The first steps of a survey like the one contemplated, are as follows:

1st. To obtain a correct knowledge of the rock formations upon which the soils are based, and to define as exactly as possible the limits of each of the grand divisions.

2d. To examine into the nature, amount, and value of the various useful minerals which occur in the rocks.

3d. To ascertain the nature of the various soils and the best modes of improving them.

4th. To learn what manures existed, which either in their natural state or by some slight change in their composition might be rendered valuable to the agricultural community.

5th. To collect so far as practicable the statistics of agriculture in order to show the relative fertility of the different soils, and to note the best methods of cultivation.

With the exception of the last requirement, I was able to decide most of these questions in a satisfactory manner. But it is evident that while travelling from one district to another it would be impossible for me by my unaided exertions to collect all the facts appertaining to statistics; and I expected more aid in this department from the agriculturists than I have actually received.

Blank Farm Reports were printed and circulated extensively, and it was confidently hoped that by filling and returning them to me the farmers might contribute much towards a knowledge of their important art. In this I regret to state we have too generally been disappointed, for among the hundreds of farm reports distributed by the general committee and myself, but few have been returned.

All the facts I could obtain while engaged in my operations in the field, I shall embody in the present report, and the information, I trust, will not be found deficient in interest or importance, although not so complete as could have been desired.

By collecting and analyzing accurately the various soils of the State, I hope a good and substantial foundation has been laid for agricultural improvements, and the statistics which may be obtained hereafter relating to this subject will become much more valuable to the community.

With respect to the great rock formations I would observe, that our information was in all cases obtained from a direct and personal examination of each distirict in question, and the limits of the rocks are represented upon the geological map accompanying the present report, while the order of the superposition and the relief of the country are represented by sectional views.

In order not to render the map too complicated, the superficial deposits of diluvial and alluvial soils are omitted, and the map represents the State as it would appear if the soil should be entirely removed from the rocks below and expose their naked surfaces. The limits of the tertiary deposits kindly furnished by Mr. Owen Mason, are however represented upon the map, but this does not entirely conceal the rocks.

Those minerals which are useful in the arts, required and received a large share of my attention, and they were therefore collected and analyzed with great care. Their extent was also measured or estimated as the cases required.

The examination of the soils was considered to be of paramount importance, and hence no labor has been spared in rendering all possible service in this department, by collecting numerous specimens of each variety both of the top and sub-soils, cultivated or in their natural state, and submitting them to the most rigid chemical examination.

Thus no less than 150 specimens of soils were collected from different regions in the State, choosing always those respecting which we either had positive information or expected to receive from the cultivators an account of their fertility. These soils were submitted to chemical analysis, and the results are herewith presented.

Substances valuable as fertilizers, amendments, or manures, have received a large share of my attention ; and in this department, I trust that our researches will prove useful. Specimens of every substance, which in its natural state, or by slight alteration, might be converted into enriching manures, have been collected and analyzed, and their composition with some remarks respecting their management, will be appended so as to render the researches practically useful.

Section from Providence to Diamond Hill, in Cumberland.

Providence is based upon conglomerated rocks, alternating with carboniferous clay slate, or shale; the latter rocks occupying the lowest position in the series. In this formation are found occasional remains or impressions of vegetables, chiefly of the fern tribe of plants, and a few beds of anthracite of an unknown extent. The coarse conglomerate composes the upper or over-lying stratum, and consists of various rounded or oval shaped pebbles of the primary rocks cemented together by an argillaceous paste, derived from the decomposition and attrition of similar materials, the whole being compactly indurated, doubtless by heat of the subjacent rocks, and by the pressure of a formerly super-incumbent ocean.

This coarse conglomerate graduates into a very fine and compact rock, composed of the fine particles of the same materials, which are so closely compacted, as to give it sufficient firmness for the construction of buildings and stone walls, of great durability.

Upon this rock formation rest vast diluvial accumulations of the detritus of primary rocks, such as boulders of granite, gneiss, hornblende and epidote rocks, and masses of iron ore, derived from certain localities, to the northward.

The same rocks continue to form the sub-stratum until we reach Cumberland, and in that town give place to huge masses of granite, quartz, hornblende and other rocks, of an unstratified nature, which have been thrown up in an incandescent state by subterranean power, producing various chemical and mechanical changes in the stratified rocks resting upon them.

Details of the Cumberland Section.

Leaving Providence and proceeding towards Cumberland, we noted the following facts respecting the rocks.

At Pawtucket, the conglomerate or grau-wacke alternating with clay slate, occurs abundantly in regular strata, which run north and south, and dip 80° to the eastward. The slate is glazed with carbonaceous matter similar to indurated plumbago. On the exposed surface of this ledge where the soil has been recently removed, diluvial furrows or scratches are quite distinctly seen, running by the compass, N. 10° E., or S. 10° W. Between Pawtucket factories and Valley Falls there occurs a red slate, which derives its color from the presence of per-oxide of iron, and alternates with the fine grau-wacke rocks.

The strata at that place run N. E. and S. W., and dip to the S. E. 80°. The superincumbent soil is light and sandy, bearing a natural growth of pitch pines.

At Valley Falls factory, on the borders of the Blackstone River, the grau-wacke rocks also occur, and there are seen to run Northeast and Southwest, and dip to the Southeast 80°.

Proceeding to Cumberland, we come next to the pits that were opened for the exploration of a bed of anthracite, but which are now abandoned and are filled with water, so as to preclude any examination of the coal bed, and only allowed me to note the nature of the including strata of rock, which I found to run N. 10° E. and S. 10° W., and dip to the northward 45° or 50°. Specimens of the coal were obtained from among the rubbish at the mines, and others were selected from a quantity that had been sold in Providence. All of the specimens thus obtained, I have analyzed, and their composition will be stated in another section of this Report.

The soil at the coal mines was found to be 28 feet thick, and the new shaft sunk for coal, was stated to be 67 feet deep. Having examined the surrounding rocks and collected specimens of them, I proceeded to Diamond Hill, which is an abruptly precipitous mountain of quartz rock, agatized in some places, and intermixed with fragments of jasper and other accidental minerals; such as druses of quartz crystals, phosphate of lime, and veins of red hæmatite iron ore.

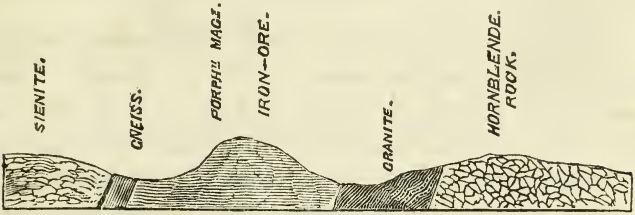
The iron ore occurs on the southern slope of the hill, about half way from its base to its summit. The veins are about six inches wide, and their cavities often contain beautiful botryoidal and stalactical groups of the ore forming interesting specimens; but there is not a sufficient supply of it for the manufacture of iron.

This hill is much visited by mineralogists for the sake of the beautiful specimens of agate chalcedony and quartz crystals, which abound in it. The former minerals constitute the principal mass of the hill, and are especially beautiful at its summit, where they can be easily broken off from the huge detached masses of rock. The country around is generally level ; and the large and rich intervals give an abundant reward to the husbandman.

We next visited the Iron Mine Hill, which is a mountain mass of porphyritic magnetic iron ore, 462 feet in length, 132 feet in width, and 104 feet in height above the adjoining meadow. From these measurements, which were made over only the visible portion of this enormous mass of iron ore, it will appear that there are 6,342,336 cubic feet of the ore above natural drainage.

$$\begin{array}{rl}
462 & \text{feet long,} \\
132 & \text{`` wide.} \\
\hline
924 & \\
1386 & \\
462 & \\
\hline
60984 & \\
104 & \text{feet high.} \\
\hline
243936 & \\
60984 & \\
\hline
6342336 &
\end{array}$$

Its specific gravity is from 3.82 to 3.88. Weight of the cubic foot = 240½ lbs. On the northern side of the Iron Mine Hill the rocks are gneiss and sienite, on its southern side, granite and hornblende rock, thus—



Section across Iron Mine Hill, Cumberland.

This ore is remarkable both on account of its geological situation, and its mineralogical and chemical composition. It appears to have been protruded through the granite and gneiss at the same epoch with the elevation of numerous serpentine veins which occur in this vicinity. This will appear the more probable origin of this mass, when we consider its chemical composition in comparison with that of the iron ore, which we know to have been thrown up with the serpentine, occurring on the estate of Mr. Whipple, and the fact that the ore at Iron Mine Hill is accompanied by serpentine mixed with its mass in every part, gives still greater reason for this belief. The following analysis represents the chemical composition of this ore.

Results of chemical analysis of 100 *grains of Porphyrytic Iron ore from Iron Mine Hill, Cumberland.*

Per-oxide of Iron =	27.60
Prot-oxide of Iron	12.40
Silicic Acid	23.00
Titanic Acid	15.30
Alumina	13.10
Magnesia	4.00
Manganese	2.00
	97.40
Water and loss	2.60
	100.00 grains.

On the summit of this hill are a few spots covered with a thin soil, and the forest trees are generally small oaks. On the southern declivity the soil is sandy and the forest trees are pines.

I next visited the limestone beds which occur at Cumberland Hill, upon the estate of Mr. F. Brown. These beds run N. 25° W., S. 25° E., and dip N. N. E. 35°; and the width of them was found to be from six to ten feet.

It slopes in such a manner that it must evidently be overlaid in part by the granite rocks, which have been protruded through its strata. It runs over the hill in a direction N. 20° W. In this limestone occur numerous particles of copper pyrites, scattered through its mass. Tremolite, asbestus, actynolite, and a number of curious minerals common to such limestones also occur.

Near Sneech Pond there is an ancient mine, sunk apparently for the purpose of extracting ores of copper, which are found there mixed with veins of granular magnetic iron ore. The shaft slopes to the N. E. by E. following the dip of the vein, and is 20 to 30 feet wide, but it has for a long time been filled with water, so that its depth has not been ascertained.

Near the pond occurs a very thick bed of a remarkable ore of manganese, which is peculiar in its composition, but most nearly resembles the Knebelite of Beudant. The bed is no less than forty feet thick, and when any method of making use of the mineral is discovered it may prove an important locality. One hundred grains of this mineral was taken for analysis, and the following results obtained:

Silicic Acid	26.400
Prot-ox. Iron	35.912
Prot-ox. Manganese	32.488
Carb. Acid	5.200
	100.000

Another specimen yielded,

Silicic Acid	29.400
Prot-ox. Iron	37.707
Prot-ox. Manganese	27.692
Carb. Acid	5.200
	99.999

Specific gravity, 3.7881, mean of three specimens.

Associated with this mineral occur crystals of green quartz, or prase, and veins of quartz penetrated by delicate green crystals of actynolite, forming a kind of ornamental stone, for which the name Thetis Hair Stone has been proposed. Sulphuret of molybdena also occurs in the manganese ore, and the yenite formerly discovered near this place is said to have been found in the accompanying quartz veins. Ligneous actynolite abounds in veins with the quartz above mentioned.

Several excavations of considerable extent have been made in this vicinity, and were probably prompted by the discovery of masses of yellow copper pyrites, which was doubtless mistaken for gold, as it generally is by persons unacquainted with mineralogy.

It is worth remarking that there are no less than fifty different ancient mine holes in this hill, and it is estimated that more than half a million of dollars must have been expended in these fruitless researches for the precious metals.

The iron ore appears to have been generally neglected, although when wood was abundant in this vicinity it might have been profitably wrought for iron.

At one of these ancient mines it was easy to discover what minerals were sought for, since one of the casks in which the ore had been packed for the purpose of sending it to England, had been left, and from among its broken and partly decomposed staves we picked up an abundance of the yellow copper pyrites, which is found accompanying the granular magnetic iron ore.

I took a fair specimen of this ore and subjected it to separation by the magnet, and then reduced the copper ore which was left. It contains in 100 grains of the picked copper ore—

Copper	36.842
Iron	31.940
Sulphur	31.218
	100.000

Beacon Pole Hill, in Cumberland, is composed of a variety of granite, having hornblende substituted in the place of mica, constituting a rock called sienitic granite.

This stone is a beautiful material for architecture, and an inexhaustible quarry of good stone may be opened upon this hill. The naked rock is exposed over an area of more than a quarter of an acre, and much more may be easily uncovered of its thin layer of soil.

The rock splits well and is free from pyrites or other injurious substances, and may be advantageously worked.

This eminence is by barometrical measurement 200 feet above the level of the ground at Cook's tavern, on Cumberland Hill, and 556 feet above the sea level.

On its summit a beacon light was placed during the war of the Revolution, whenever it became necessary to call forth the minute men from the surrounding country, which it commands for a great distance ; but the hill is not so high as Woonsocket Hill, as was shown both by the barometrical and trigonometrical measurements.

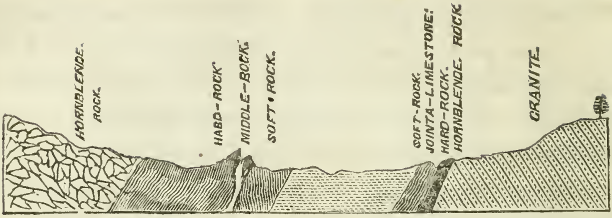
Granite blocks of large dimensions occur in abundance near Diamond Hill, and are wrought into blocks which are sent to Providence for architectural use.

Section from Providence to Smithfield.

Travelling from Providence to Smithfield lime quarries, by the route of the Louisquiset turnpike, we observed the following rocks. From Providence, for the distance of four miles, the strata of grau-wacke belonging to the anthracite coal formation, are uninterrupted and uniformly dip to the northeastward; then we come to a large granite vein, which is included in the above mentioned stratified rocks, which it has indurated and considerably changed in texture. Passing the North-Providence line, we examined a hill composed of metamorphic or altered grau-wacke rocks, of fine texture, and compact in structure. We then come to porphyrytic granite, intersected by a narrow dyke of greenstone trap rock.

On the Aza Arnold farm, we examined several small beds of limestone, similar to that which will presently be described. We then arrived at the lime quarries, which are extensively wrought by Messrs. Harris and others. This limestone is very remarkable, and will require a particular description on account of its geological relations, its chemical composition, and its great commercial value.

It is included immediately in greenstone or hornblende rock of a dark brownish green color, compact in structure and exceedingly hard. The hornblende rock itself is imbedded in granite, and it is yet undecided whether we are to consider the former a rock of igneous injection, or like the limestone, a metamorphic stratified rock, altered by the igneous power of the subjacent granite. It is however probable that the hornblende rock has exerted a powerful chemical influence upon the limestone, and it will appear by an accompanying section that it has rendered it highly magnesian at the points of contact with it, this change being of much greater extent than is easy to understand by our present knowledge of the properties of magnesian rocks when subjected to igneous fusion.



Section across the great bed of Limestone, at the Harris Rocks, Smithfield.

It is probable that the hornblende rock is of igneous origin, and was protruded from below the granite. Where it presents traces of a slaty structure it may have been owing to its union with rocks of sedimentary origin, such as the clay slates. The limestone has strata marks more or less contorted, showing that it was originally an aqueous deposition, but has since undergone partial fusion. The Harris limerock is largely wrought, it being considered the best quarry, and is usually known by the name of the Jointer Ledge, a name derived from the joints in the rocks.

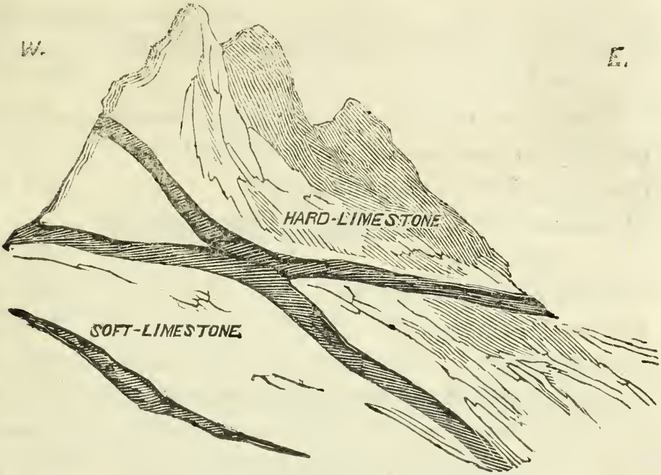
That portion of the limestone which lies in contact with the hornblende rock, is called the Hard Jointer, and is the variety of magnesian carbonate of lime called Granular Dolomite. About ten feet from the hornblende rock the limestone graduates into pure granular carbonate of lime, occasionally colored with plumbaginous matter, oxides of manganese, and iron.

The bed runs W. N. W., E. S. E., and dips to the N. N. E. 70°.

At the middle rock are seen two high conical masses of limestone, one being the hard or magnesian variety and the other soft or granular carbonate of lime.

One of these masses is cut through by dykes or rocky veins of greenstone-trap, which originated in the regions below granite, and has been protruded through that rock and into and through the limestone.

The following wood cut represents the appearance of this rock.



Sketch of the Middle Lime Rock, Smithfield.

The dykes are closely connected with the limestone, and the trap has fused and cemented itself to the limestone at the points of contact.

Estimates of the expenses and profits of burning lime at the Harris rocks, middle hill, soft rock, the manufacturer owning the quarry.

Estimate for 350 casks of lime.

Quarrying the limestone $50, carting to kiln $25,	$75 00
Attendance on kiln $20, and filling out $12,	32 00
40 cords of wood at $4 50,	180 00
350 lime casks at 45 cents,	157 00
Carting to Providence 20 cents,	70 00
Rent of lime kiln,	20 00
	$534 50
350 casks of lime sell in Providence at $2 net.	$700 00
	534 50
Leaving profit in burning and value of rock,	$165 50

The rock would sell at 12 1-2 cents per cask in ledge, hence deduct	43 75
Clear profit in quarrying and burning 350 casks of lime,	$121 75

The following is an estimate of expenses and profits in burning the hard rock of the middle hill.

Quarrying $35, carting to kiln $25,	$60 00
Attendance on the kiln $20, and filling out into casks $15,	35 00
35 cords of wood at $4 50.	157 50
450 casks at 45 cents.	202 50
Rent of kiln,	20 00
Carting to Providence at 1 shilling per cask.	75 00
	$550 00
400 casks lump lime netting in Providence 10 s.	666 67
40 do. ordinary do. net 7 shillings,	46 67
10 do. first quality do. net 12 shillings,	20 00
	733 34
	550 00
Value of rock in ledge and burning profit.	183 34
Rock worth in ledge 10 cents.	45 00
Net profit,	138 34

Estimate of Mr. Wright, who burns lime under the lessees of the Dexter Rock.

For the rock in the ledge, for the use of kiln, and for steam engine for pumping water from the quarry.	$150 00
Expense of getting out water preparatory to quarrying rock,	40 00
Cost of quarrying $50, and hauling rock out of pit $40,	90 00
Drawing to and filling kiln.	40 00
Tending kiln 26, filling out 30,	56 00

Pointing kiln,	5 00
540 casks at 45 cents,	243 00
75 cords of wood at 5,	375 00
Carting to Providence at 20 cents,	108 00
	$1107 00
540 casks of lime sell for	$1260 00
	1107 00
Profit on quarrying and burning,	153 00

Seven turns of 24 hours each—two men employed at $13 each for burning a kiln of lime.

One attempt has been made at the Harris quarries to burn lime by means of anthracite coal, but without success, owing probably to want of skill in the persons employed. I have no doubt that great advantages may result from the introduction of the perpetual coal kiln, and since there will be a great demand for lime for the purposes of agriculture, it will be desirable to furnish a lower priced article than that which is now manufactured. In case lime is burned for this purpose, it is essential that only the soft rock should be used, since the hard variety is magnesian, and will not answer the purposes of agriculture.

The lime kilns at present used in Smithfield are very large, and are built so as to contain 500 casks of lime, but it is said that by the expansion and wearing away of the rock, they are soon enlarged so as to contain 550 or 600 casks.

In operating upon so large a mass of limestone the fire is driven for seven days and nights incessantly, a good draught being kept up by means of an ash-pit opening, with a grate of bar iron; a large iron fire-door, being closed after each addition of fuel. These kilns are vastly more economical, as respects fuel, than those used at Thomaston, in Maine.

The calcined lime is very nearly of the same bulk with the rock before burning, and it is said to lose but one third of its weight in the process. Provided the carbonic acid is entirely expelled it should lose 44 per cent of its weight, but this is rarely effected in large operations.

It is remarkably white and slakes into a very strong hydrate of lime.

The granular varieties are granular after slaking, while those that are compact are converted into a very fine powder.

The magnesian limestone or hard rock is said to be generally preferred by masons, since the mortar hardens sooner than if made of pure lime. The magnesia renders it somewhat hydraulic. The soft rock is pure and fit for agriculture, as will be seen by the analyses annexed. (See tables of composition of limestone.)

PERPETUAL KILNS.

The following is an estimate of expenses and profits in burning lime by means of small anthracite coal, in a perpetual kiln, owned by Mr. Curtis, in Boston, the limerock being brought from Thomaston, Maine, and costing 50 cents per cask. The kiln burns 26 casks of lime per diem. Coal costs from 2 50 to $3 per ton.

26 casks of lime rock costing 50 cents each,	$13 00
2 tons of anthracite coal at $3 per ton,	6 00
Labor of three men at $1,	3 00
Labor of one horse to raise the rock to kiln,	50
Interest on cost of kiln, $900, 15 cents per day,	15
Cost of 26 casks of lime in bulk,	22 65
26 old lime casks costing 12 1-2 cents,	3 25
Cost of 26 casks of lime for sale,	$25 90
The lime sells at $1 12 per cask,	29 12

26 casks of lime sell for	29 12
Deduct cost,	25 90
Daily profit,	3 22

Or profit per cask 12 1-2 cents nearly, or $966 in 300 days. The kiln is kept in action throughout the year.

There must be a considerable variation in the profits at different times, since the price of the coal varies, as also does the price of lime, which sometimes sells for $1 25 per cask. Masons prefer buying freshly burnt lime, since it is more caustic, and there is also a saving from the fact that no waste takes place by the sifting of lime from the casks, when they have not undergone much disturbance by transportation.

Having examined many specimens of lime burned by coal and by wood, I feel sure that the lime which is properly burned by means of anthracite is equal in whiteness and in strength to that burned by wood fuel. It is necessary however that the workmen should learn by experience how to regulate the draught of the kiln in order to prevent the fusion of the lime rock into a slag.

There is a perpetual lime kiln in Charlestown, owned by Mr. Gould, who burns Thomaston and L'Etang lime-rock by means of anthracite small coal. I visited this kiln, obtained a plan of it, and learned the following statistics through the politeness of Mr. Gould.

The kiln cost $900. It is built of Charlestown clay slate, and is lined with red sandstone.

The kiln is 19 feet high, 11 feet across the top, inside, 12 feet wide at the boshes, (the widest inner part near the middle of the kiln,) and two and half feet wide at the hearth.

The accompanying view of this kiln, sketched by G. T. Devereux, will give a good idea of its appearance, with its out-buildings, &c.

Limerock costs $2 per ton, delivered at the kiln, equal to 50 cents per cask. Small anthracite coal costs $2 50 to $3 per ton. Three men are employed, whose wages are, for the foreman $35 per month, and the other men receive $1 per day. The kiln burns 30 casks of lime per day, and two and a half tons of coal are burned. The work goes on throughout the year incessantly. The lime sells for from $1 12 to 1 25 per cask. Old casks are used which do not cost more than 12 1-2 cents each. The casks contain from 278 to 300 lbs. of lime, when of the large size or old casks, and 240 lbs. when the new casks are used.

The lime is well burned, is cold when it comes from the kiln, and is immediately packed into the casks and headed up, so that the men attending the kiln are constantly employed. The coal being entirely consumed before it reaches the drawing arches, the lime comes out cool enough to handle. The pieces are always examined to ascertain whether they are thoroughly burned and free from core, and not slagged. In case the rock is not well burned it is returned to the kiln. This happens only when very irregular and large masses of the rock are thrown in.

It is customary to break the rock into pieces about six by four inches, or somewhere about that size. They ought not to be too small, because there would be danger of fusion, and if too large, they are not well burned.

By the above statistics it will appear that the cost of burning lime for one year, allowing 300 working days for the year, will be as follows :

Interest on cost of kiln, $900, at 6 per cent per annum,	$54 00
Two and a half tons of coal per day, per year,	2250 00
Lime rock for 30 casks per day, at 50 cents per cask, per annum,	4500 00

Labor, 1 foreman at $35 per month, and 2 laborers at $1 per day,	1020 00
9000 old lime casks at 12 1-2 cents,	1125 00
Use of horse for hoisting lime rock and carting, expenses 50 cents,	150 00
Cost per annum for 9000 casks of lime,	$9099 00

Therefore each cask costs the manufacturer, $1 01 1.

If the lime sells for	$1 12 5
Deduct cost,	1 01 1
Profit per cask,	cts. 11 4

Or on 9000 casks, $1026, for one year's profits.

Or if the lime sells for	$1 25
	1 01 1
Profit per cask,	23 9 = $2151

profit per annum.

Shell Lime.

Shell lime is manufactured in Johnston, by Mr. J. W. O. King, who has erected a kiln for the purpose near Knight's tavern.

This kiln I examined and found it to be 15 feet high, 5 feet in diameter at its mouth, 6 feet in the middle, and 2 feet at the hearth. The arch opening is 2 1-2 feet high, and through this opening the calcined shells are discharged. It contains a charge of 200 to 350 bushels shells, and the burning requires from 8 to 12 hours, according to the degree of completion required. He calcines them but 8 hours for agricultural use and 12 hours when they are to be used for cement.

It requires 350 lbs. of anthracite coal, egg size, to prepare a kiln of lime for agriculture, and 400 to burn the shells into quick lime. The coal costs $8 per ton.

The shells used are the quahog and oyster, and they cost him eight cents per bushel delivered at the kiln. During the past year he has burned and sold 1500 bushels of shell lime.

One man only is required to attend the process of burning. The shell lime sells for 12 1-2 cents per bushel, and is used to some extent in agriculture.

Mr. King informed me that he had used this kind of lime on his land with very good results, both by spreading it broadcast and also by composting it with his manures. He says that he has used it on uplands and on meadows, and on corn, oats, potatoes, and grass, and considers it of great value as a top dressing.

It would be easy to make a perpetual kiln after this model, or perhaps it would be more economical to build one of larger dimensions, as much fuel may be saved in larger operations.

Near the printing establishment at Mr. Samuel Arnold's, are seen the out-croppings of two beds of limestone, which may be observed in the pasture; and on examination, the rock was found to be a compact grained white limestone, forming beds twenty feet wide, and running N. 30° W., S. 30° E., and dipping to the North-Eastward.

Limestone also occurs on the estate of Israel Arnold, Jr. and is there included in walls of hornblende rock, associated with asbestus, talc, nephrite, and tremolite. The bed runs N. 75° W. and dips N. N. E. 70° and is 60 feet wide.

Dexter Rock.

At this rock ten kilns of lime are burnt per annum, and there are two lime kilns in use, each of which contains 500 casks of lime. No less than 10,000 casks of lime have annually been sold from these kilns during the last forty years.

The establishment is ancient, the rock having been quarried and burnt for more than eighty years. It was leased to a number of individuals, and by them under-let to others.

Mr George Smith furnished me with the following estimate of the cost and profit on burning 500 casks of lime, at this place.

Ninety cords of wood, $5,	$450 00
Quarrying 500 casks of rock,	100 00
Carting,	50 00
Packing and burning,	75 00
Transportation to Providence,	100 00
500 casks, at 45 cents,	225 00
Lease,	2 25
	$1002 25

Commission, one shilling per cask.

The Smithfield lime kilns, are capable of burning 450 casks of lime at a time. They are eleven feet in diameter at the top, bulge in the middle to fourteen feet, and then contract at the bottom to eight feet. The height from hearth to top is twenty-one feet, and the depth back from front to rear, is at the bottom, fourteen feet.

Beneath the kiln there is an ash pit, or drop arch, which is kept free from ashes by a scraper. During the burning, a fire-door above closes the opening when wood is thrown in.

Near the Smith mansion house, about twenty rods to the eastward, there is a bed of limestone, two rods wide.

There is also a lime kiln ten feet diameter and twenty feet high, capable of burning 500 casks of lime at a charge.

Estimate of expenses and profits in burning 450 *casks of lime.*

Cost of rock quarried, 77 cents per cask,	$346 50
Carting and filling kiln,	30 00
Attendance $24, filling out $13 50,	37 50
450 lime casks at 45 cents,	202 50
60 cords of wood at $5,	300 00
Extra expenses, pointing kiln, &c.	10 00
Cost of 450 casks of lime at kiln,	$926 50
Carting to Providence at 20 cents,	90 00
	$1016 50
Sell in Providence at 14 shillings per cask,	$1050 58
Cost,	1018 50
	34 08
Two per cent off for guarantee on sales,	21 00
Net profit in burning 450 casks of lime,	$13 08

In this estimate we must consider that employment is furnished to the persons concerned, and that they estimate their wages as if employed by others. So we have to consider $13 08 as the clear cash profit beyond labor.

The dolomite or hard rock is said to burn more readily than the soft variety, and slakes more slowly and finer than the soft lime rock.

The granular soft rock is estimated to require about one eighth more fuel than the hard rock for burning it into lime. It slakes rapidly on the first contact with water, and makes a granular white hydrate of lime.

The mineral called Rhomb Spar has been erroneously named, for is not a magnesian limestone, but contains a considerable proportion of carbonate of manganese. I tried some of it, and found that it burned to an ash gray lime, and slaked with great difficulty, requiring hot water for the purpose.

Specimens of every kind of lime at the Harris rocks were taken and slaked in my presence, and since then I have analyzed selected specimens of the various rocks from which they were obtained.

The Smithfield lime is generally much whiter than the ordinary lime of commerce, and sells at a much higher price.

South Rock. About a quarter of a mile south from the middle lime rocks the limestone again shows itself rising above the surface of the soil, and presents a broken and crumbling mass of granular limestone of the soft variety. Where it has been disintegrated by the action of the frost, it forms a coarse granular soil, too porous for luxuriant growth of vegetables. The alluvial deposits below the hill are probably charged with a portion of the finer particles of this calcareous earth, and at the time of my visit I observed a barley crop just put forth and appearing in very good condition.

On the estate of Capt. John Jenckes, near the northeast side of the Reservoir, on Moshassuc stream, there is a bed of soapstone or talcose rock, twelve feet wide, included between walls of chlorite slate. This rock is found to be very useful as a lining for the lime kilns, owing to its refractory nature.

A quarter of a mile west from this place the great bed of Smithfield limestone terminates. It extends in length about one and a half miles continuously, from S. 25° E. to N. 25° W. and dips quite regularly to the notheastward.

In one place on Captain Jenckes' farm it is evident that a granite vein cuts through the limestone. At this point occur some of the silicates, such as asbestus and tremolite, which exist in fibrous masses and radiated crystals.

Proceeding northwardly we came next to a bed of argillaceous and chlorite slate which occur near the road upon the estate of Burrill Hutchinson. The strata run north and dip E. 60°.

Woonsocket. The rocks in this town are chiefly micaceous and talcose slates, and an important deposit of granular quartz, passing into talcose slate, occurs, forming a mountain mass of considerable elevation.

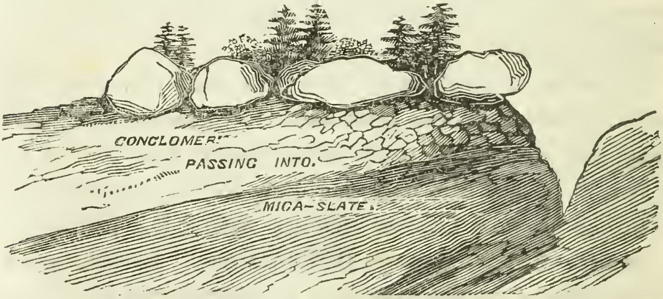
On the estate of L. Southgate, a mile and a half from the state line and northwest from the village of Woonsocket, the talcose slate is seen running N. 35° E. and dips E. N. E. 12°.

A boulder of granite is seen resting upon a ledge of mica slate.

It evidently originated at some distance northward, and has been transported to its present situation by the diluvial current of ice and water.

The micaceous slate is extensively wrought for the manufacture of sythe stones in numerous places in this vicinity.

The following section shows the passage of a conglomerate rock into mica slate, a fact frequently observable at the junction of the rocks of aqueous, and those of igneous protrusion.



Sythe Stone Quarry, Woonsocket.

Sythe stones are made of the fine-grained, soft variety of this micaceous slate, and in some specimens there is a small proportion of talcose matter.

Those beds that are wrought, are generally of a brownish, or of a silvery grey color, having a basis of very fine granular quartz, which is bound together by fine scales of mica and talc.

The stone is easily cut with a hatchet into the forms desired, and then the pieces are ground with sand upon a grindstone until they are smooth and of regular form and dimensions.

A profitable manufacture of whetstones is here carried on, and from five to seventeen thousand dozen are annually furnished for sale. The present year ten thousand dozen have been manufactured.

The stones are cut from 10 to 11 inches long and about two inches wide and half an inch in thickness. Those of the first quality sell for 65 cents per dozen. One man cuts 10 dozen per day, after the rock is quarried. The cost of quarrying is 8 cents per dozen. Grinding costs 6 cents per dozen. Owners of the ledge demand 5 cents per dozen for the right of quarrying the stones. Thus,

Right of quarrying out the stones per dozen,	5 cents.
Quarrying per dozen,	8
Labor,	10
Grinding,	6
Boxing up for market,	9
Sand for grinding,	1 1-2
Carting,	0 3-4
Transportation to Philadelphia or New-York,	2
Cost,	42 1-4

From the statements which I have collected it will appear that the manufacture of sythe stones pays fair wages for labor at its usual rate, especially where the best stones are wrought, for which they obtain 65 cents per dozen. The prices I was informed varied from 28 to 65, the mean of which is 46 1-2. Deduct cost, 42 1-2, and it leaves 4 1-2 cents clear profit, after allowing for labor. If the stones sell for 65 cents per dozen, and cost 42 1-4 cents, it leaves 22 3-4 cents clear profit.

The light silvery grey stone which is wrought on the south side of the hill, is very handsome, and it now brings the highest price in the market. Nathan Aldrich and L. Southgate are the owners of the quarries and let to others the right of obtaining the whet-stones.

At Woonsocket Falls, the rocks are stratified, consisting of blue mica slate, and the strata run N. E., S. W., and dip S. E. 60°. At this place the river falls from a dam from 15 to 20 feet.

Woonsocket Hill is one of the highest points in the State, and is composed of granular quartz, mica and talc. The former mineral greatly predominates. It is stratified, and the strata run N. W., S. E., and dip N. E., N. 20°.

This rock is one of the most refractory substances in fire, is extensively wrought for the supply of hearth stones to furnaces, and is used for that purpose in all the Atlantic States.

The price of the stones for the hearths of iron furnaces, is at the quarry, in Smithfield, $5 per ton, or $8 if delivered in Providence.

This rock extends to the northwest until it reaches the town of Uxbridge, where it crops out near the Douglas turnpike. It evidently belongs to the group of stratified rocks which are classed as belonging to the primary series, and is geologically a part of the mica slate formation.

Woonsocket Hill is estimated to be 570 feet above the high water mark at Providence, and is by my measurement 340 feet above the immediate base, and 258 above the ground at Bartlett's Hotel. Thus we estimate its height above the sea to be by measurements, 340 feet above the brook at its base. By estimation the brook is 50 feet above the dam on Blackstone river. Blackstone river is 180 feet above high water mark, making 580 feet to sea level; measuring to Woonsocket village by triangulation, it was found to be 257.2 feet above that point, and by barometer, 258.16, making a difference of 0 ft. 96.

UXBRIDGE. Near the line between the States of Rhode-Island and Massachusetts, within the jurisdiction of the latter State, there occurs a vein of galena, or lead ore, in a rock identical with that of Woonsocket Hill. This vein was found on the estate of Chilion Tucker, on the road from Millville to Alum Pond, and has been opened to a small extent, by the proprieter of the land, who stated to me that it was at first but one and a half inches wide, and widened to 8 inches in descending four feet into the rock. On examination I found the ore to be included in a vein of quartz and felspar, which seems to have been injected from below the superincumbent strata. Associated with the galena we find black blende, or sulphuret of zinc. Arsenical iron and copper pyrites also occur in similar accompanying veins. I took a specimen of this lead ore, and cupelled it on the spot, and found a large proportion of silver in it. Since my return to Boston, I have made a minute chemical analysis, and have obtained 0.355 per cent of silver, or 7.110 pounds of silver to the ton of the ore. Every cubic foot of the ore weighing 484 pounds, will contain *lb.* 1.718 of silver, and a vein eight inches wide may be advantageously wrought. The lead vein runs N. 25° E. and dips to the S. E. The rocks near Alum Pond, are gneiss and mica slate.

On Pascoag river, a little north of the village, gneiss and mica slate occur, and dip to the N. E.

In Chepachet, near the turnpike, a variety of compact thick bedded gneiss is quarried, and is known by the name of the Pine Orchard Grit. It occurs two miles west from the village. Eastward from this place we saw a large bed of black mica, associated with a little granular quartz. It presents itself on the road side, included in gneiss, and is cut through by a granite vein.

In Greenville the rocks are entirely of the primary class, consisting of gneiss, mica slate, and granite. The soil is generally good, especially in the meadow lands. The same rocks continue through Glocester, and the soil originated entirely from granite diluvium, and frequently contains large quantities of granitic boulders. The soil of the intervales is of good quality, containing a considerable quantity of vegetable matter.

Leaving Providence, and proceeding westwardly through Olneyville, and along the Hartford turnpike, we noticed the following order of rocks and soils. Near Providence, there are tertiary and diluvial banks of gravel and sand; next, are seen argillaceous slates, belonging to the coal formation, of the grau-wacke series; and then gneiss. The slate rocks run north and south, and dip to the east, while the gneiss dips to the northeast, and runs northwest and southeast. The soil is generally good, consisting principally of dark blackish grey loam, especially in Johnston and Scituate. Peat is found in most of the low lands. Near Harley Phillips's tavern in Scituate, the rock is granite-gneiss, which forms thick beds dipping to the northeast, 30°. Numerous boulders of the same rocks are also found in the soil.

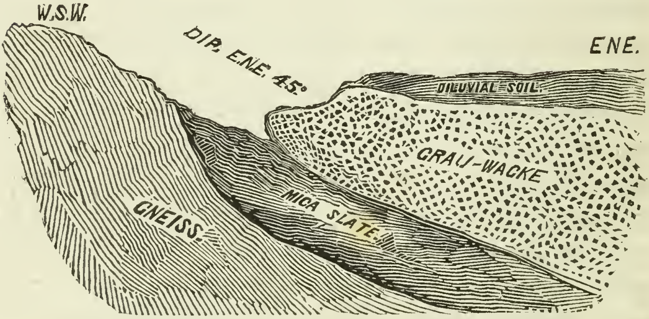
In Foster, gneiss is the predominant rock, and is here and there cut through by granitic veins. On the estate of Thomas Bennet, south of the Hartford turnpike, 19 miles from Providence, and two and a half miles from the Moosop river, occurs a large and important bed of bog iron ore, which I carefully examined. This deposit is 132 feet long, 66 feet wide, and at least 3 feet deep, making by calculation 26,136 cubic feet of iron ore, which weighs 100 pounds to the cubic foot, and contains 34 per cent of iron, equal to 444½ tons of iron in the bed.

In a swamp about ten rods in length, one mile S. W. from this deposit, there is another bed of a pulverulent kind of iron ore, upon the estate of Mr. Hopkins, which was formerly wrought to a limited extent. It is 600 feet long, 64 feet wide, and two feet deep. Another bed of bog iron, which belongs to the Foster Banking Company, was examined by me, and was found to be 200 feet long, 119 feet wide, and 2 feet deep, equal to 47,600 cubic feet. It is evident since these localities are situated so near each other that the ore may be collected and wrought at some convenient place near by, where forges or a small blast furnace may be erected. Water power may be obtained upon the Moosop stream, chesnut charcoal may be had for $7 per hundred bushels, and hard wood charcoal for $8 the same quantity. Wood is valued at $1 per cord standing, and it costs 2 shillings per cord to cut it. Delivered upon the road, it now costs $2 per cord. Mr. Bennett says that upon his land the wood will average about 20 cords to the acre, and that he owns 100 acres, half of which is covered with forest trees, such as maple, elm, birch, chesnut, and hornbeam. This land produces 25 bushels of corn to the acre, and one and a half tons of hay. It is probable that a few forges will be erected, for the purpose of smelting this iron ore, but there is not enough to supply a blast furnace many years.

In South-Scituate, near the Rockland factories, there occurs a beautiful variety of porphyritic granite-gneiss, suitable for architecture. It has a flesh red colored felspar for its basis, and contains black mica and a little quartz. A hill 100 feet high is composed of this rock. The gneiss near the factories runs N. 10° E., S. 10° W., and dips W. 55 degrees.

Returning to Providence, by the route through Cranston, we passed over hornblende rock obscurely stratified, and dipping to the N. W. Then we came to mica slate alternating with hornblende rock on Neutaconkanut hill, and passed over the conglomerate of the grau-wacke series, until we reached Providence. Durfee's ledge, in Johnston, is composed of grau-wacke slate, and clay slate, which dip to the south 60 or 70° east, and run north and south.

In Cranston the grau-wacke terminates, and is seen resting upon the mica slate and gneiss, one eighth of a mile north of the old Cranston bank. The following diagram shows the relations of these rocks.



Junction of the Grau-Wacke and the Primary Rocks, Cranston.

In South-Scituate, the rocks are entirely primary, and there an extensive quarry of gneiss is wrought. This stone is known under the name of the Nipmuck granite.

I visited the quarries and examined the rock minutely. It splits readily in the natural seams, into suitable sheets, for platforms, and for ashler stones, and is very easily wrought. Platform slabs are obtained from five to eight feet square, and eight inches in thickness. Ashler stones eighteen inches wide sell when cut for 50 cents the superficial foot when delivered in Providence. The cost of transportation is 14 cents per hundred weight, and 180 pounds is considered equal to one cubic foot. Small stones sell for 12½ cents per foot, and the platforms for 75 cents. The quarry is opened for the distance of eight or ten rods in length; and the head or wall of rock is 20 feet high. The strata dip N. W. 15°, and run N. E., S. W. There is a little oxide of iron between the seams, which was probably derived from the decomposition of mica, containing pyrites.

West of the quarry now wrought there is another opening 500 yards long, where the strata are from one to three feet in thickness, and dip to the N. W. 10°.

The head is 30 feet high, and much excellent building stone may be easily obtained. A few veins of smoky quartz and of coarse granite cut through the strata. Quartz crystals are also found in the veins.

Continuing on our route through Coventry to West-Greenwich, we found the rocks still to belong to the primary class, chiefly gneiss, cut through by numerous granite veins. The strata run N. W., S. W., and dip N. E. 30 degrees.

A granite vein was observed to run N. 70° E., S. 70° W., while the gneiss through which it cuts runs N. 30° W., S. 30° E. At the point of contact of these two rocks, small crystals of magnetic iron ore of an octædral form abound. On the borders of Pawcatuck stream, at Babcock's mills, the mica slate and gneiss form a huge hill, and the strata run N. W., S. E., and dip N. E. 25°.

Throughout Hopkinton, Westerly, and Charlestown, we observed that the same uniform extension of the primary rocks prevailed until we reached East-Greenwich, when we again came in contact with the grau-wacke.

Peat swamps abound in this section, and may be made to furnish an inexhaustible supply of manure so much needed for the improvement of the soils.

Excursion from Providence to Bristol.

Leaving Providence, we crossed the bridge to Seekonk, and there observed the ledges to be composed of very fine and compact grau-wacke, indistinctly stratified, but the beds were observed to dip to the S. E. 60 or 70°.

Diluvial scratches abound on the recently uncovered surface of the ledges, and run N. 5° E., S. 5° W. These may be seen where the rocks have been uncovered for the purpose of quarrying for building stone.

The rock is very hard and compact, splits into blocks of a cubic form, suitable for ordinary buildings, or for underpinning, and stone walls.

I examined several farms in Barrington and Bristol, and an account of the composition of the soils will be found in the agricultural section of this report.

After searching in vain for crystals of amethyst at the locality where they formerly abounded near Bristol ferry, I ascended Mount Hope in company with several gentlemen resident in the town; and measured its height barometrically.

June 6th.—4h. 10′ P. M. at sea level at base of the hill, bar. 30.062 Temperature of bar. 66°, of the air 65½°.
4h. 20′ P. M. at the summit of Mount Hope, barometer stood at 29.836 T′. 66 t′=64
5h. 10′ P. M. " " " 29.836 T′. 61 t′=60

By calculation 30.062=764 millimetres,=6192.4 metres,
29.836=758 " =6129.6 "

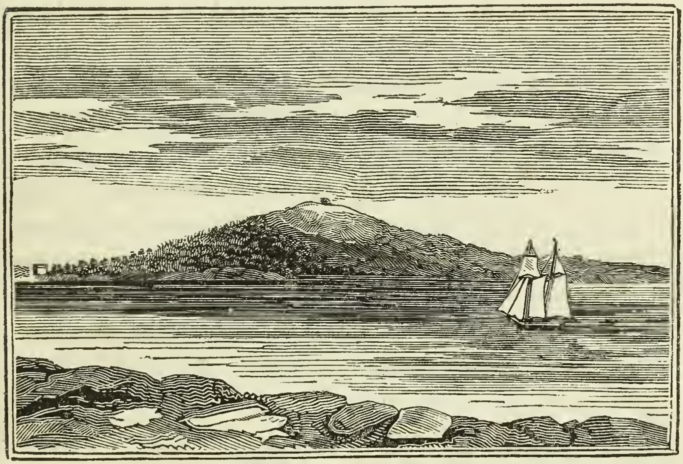
Diff.= 62.8 metres.
Diff. temp.=5° F.=2° 8 centigrade, 4.1

58.7
Corr: for latitude, curvature of earth, &c. .3

Height, = 59.0 metres.

Or in feet, 193.6

The eastern side of Mount Hope is composed of white quartz, and its western, of granite. A few crystals of quartz are found in the cavities of the quartz rocks, but they are not beautiful. This mountain commands a magnificent view of the surrounding country, and is celebrated in history as the seat of the great Indian Chief, King Philip. The spot where his wigwam stood is pointed out, and near by there is a clear spring of water, which is said to have formerly refreshed the Indian warrior. A shelving portion of the quartz rock formed his couch or chair. The swamp on the side of the hill is said to have been the place where this celebrated Indian was overtaken by his enemies and slain.



View of Mount Hope, from the shore of Mount Hope Bay, north of Bristol Ferry.

Returning from the Mount, I distributed a large number of my blank farm reports, and then crossed the ferry to Portsmouth, and thence to Tiverton, returning afterwards to explore more minutely the regions around Bristol and Warren.

At Tiverton, we again find the grau-wacke rocks, which rest directly upon the granite, as is represented by our map and section. Three miles north of Little Compton, we came to the termination of the grau-wacke, and the granite forms the basis rock. Slate strata run N. E., S. W,. and dip N. W. 65°, and are seen three miles north of Compton Plain.

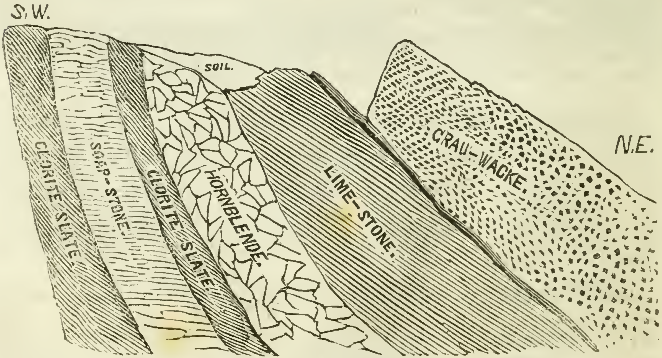
I visited the farm of Mr. Nathan Brown, four miles from Providence, and there examined an extensive bed of limestone which was wrought for lime before the discovery of the Smithfield lime-rocks. The celebrated patriot, Stephen Hopkins, is said to have been the first person who burned lime at this place.

Mr. Brown informed me that he burns about 2000 casks of lime per annum ; and that his kilns hold from 370 to 375 casks at a charge. Chestnut wood costs $4 00 per cord, and thirty-seven cords are required to burn a kiln of lime.

The kilns are 16 feet high and are contracted at the top to 11 feet, and at the bottom to 8 feet, while they swell out to 14 feet in diameter at the centre.

The lime sells for $1 25 per cask on the spot. New casks cost him 40 cents each, and they contain 40 gallons measure. Transportation to Providence costs one shilling per cask, and the lime sells for $2 50.

The following diagram shows the position of the lime-tone at Mr. Brown's quarry.



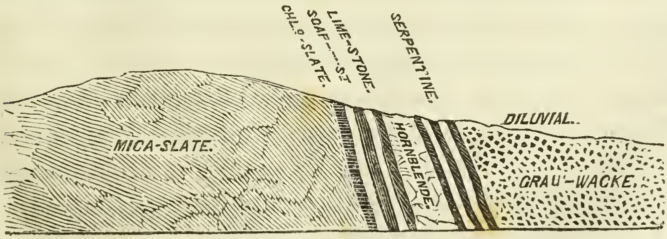
Section across Nathan Brown's Lime Quarry, Johnston.

The limestone bed is about six rods wide, and is included between hornblende rock and an overlaying mass of compact altered grau-wacke, nearly as crystalline as granite. The bed runs N. N. W. and dips northeastwardly. Chlorite slate rocks, in beds 10 feet thick, occur to the southwestward of the limestone, and include beds of talcose rock or soapstone. See in the tables appended, the composition of this limestone.

Several interesting minerals are found at this place, such as green acicular and fasciculated actynolite, crystals of magnetic iron ore, of an octædral form, in chlorite and green talc. Other beds of limestone also occur in the vicinity, and I have represented their location upon the geological map herewith presented.

Mr. N. Brown has used his lime very advantageously as an amendment to his soils, as will be seen in the agricultural section of this Report.

Limestone also occurs on the Almy farm, now belonging to Mr. William Jenkins. I examined the bed, and found it to consist of the granular and compact varieties of limestone, included in hornblende rock, associated as usual with frequent beds of chlorite slate, soapstone, and serpentine. The lime is not wrought at this place at present. The soapstone is a good article for lime kilns, and for linings to fire places, but it is difficult to obtain large slabs suitable for mantlepieces, &c. See analysis of this limestone in the appended tables.

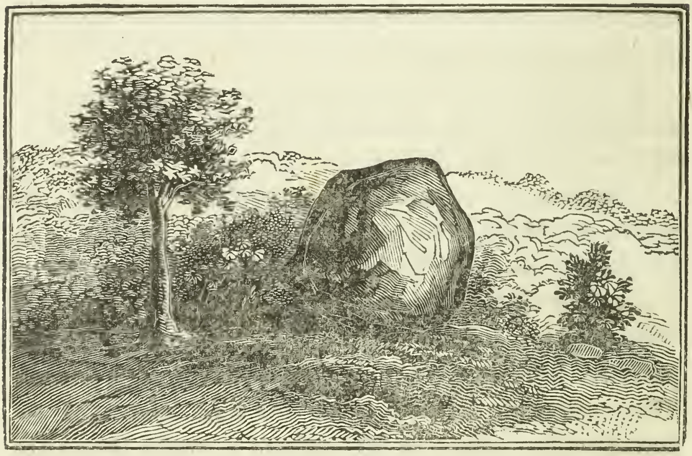


Sectional profile of the Rocks on the Almy Farm.

Neutaconkanut Hill is a remarkable eminence in Johnston, and commands a magnificent view of the surrounding country.

The rocks on this eminence are alternate strata of micaceous and hornblende slate; the former being very much contorted.

On the south side of the hill there may be seen a huge boulder of hornblende rock poised upon the mica slate, as represented in the following diagram. I am indebted to my friend, Mr. Owen Mason, of Providence, for the first notice of this remarkable erratic block.



Boulder of Hornblende Rock on Mica Slate, Neutaconkanut Hill.

This rock must have originated elsewhere; and it now rests in an accidental position, as will be evident to any one who examines the situation in which it is placed. Since hornblende rocks do occur at the northward, and not to the southward of the place where this block is now found, we feel confident that this immense rock has been removed southwardly from its parent ledge and deposited on the rocky strata where we now find it.

So frequent do examples of similar displacements occur, that every observing man must have noted them in all parts of New-England.

Warwick Neck is entirely underlaid by the rocks belonging to the Rhode-Island coal formation, namely, by the fine grained grau-wacke and carbonaceous clay slates, charged with numerous impressions of fossil plants, and occasionally narrow seams of anthracite, and plumbago or graphite occur.

In the pasture, near Captain Holden's house, some ineffectual attempts have been made to discover workable beds of coal, but the excavations rarely extended into the rocks.

I examined attentively the loose masses of slate which had been thrown out from the openings, and also those which lie scattered profusely in the soil, and found an abundance and great variety of fossil plants, such as belong to the coal formation. Where the ledges crop out they were also found to be full of these impressions, and the strata dip to the south, and run nearly east and west.

The land is sufficiently elevated to allow of easy drainage, so that if a coal bed should be discovered, it might be kept free from water. Captain Holden informed me that no excavations had been made to a greater depth than ten feet, and that the usual depth of the soil is sixteen feet.

From the abundant indications of the coal bearing strata at this place, I should think it one of the most probable localities for beds of coal, and am surprised that while so many less promising localities have been examined, so little has been done here to settle this important question.

I visited the extremity of Warwick Neck where a lighthouse 25 feet high and 40 feet above the tide water is placed. The tides here rise on an average to the height of five feet.

Tracing the rocks along the coast, we found them to be carbonaceous slate and fine grau-wacke overlaid by a coarse pebbly conglomerate at the upper part of the neck. On Messrs. Durfee and Green's farms a few small seams of anthracite had been discovered.

The strata of slate and grau-wacke run north and south and dip east 20°. They are seen all along the shore cropping out fairly to view.

The mineral spring upon this neck is formed by the decomposition of pyrites contained in the slate. Sulphate of lime, and carbonate of iron are dissolved by the water of the spring, which thus becomes a strong chalybeate.

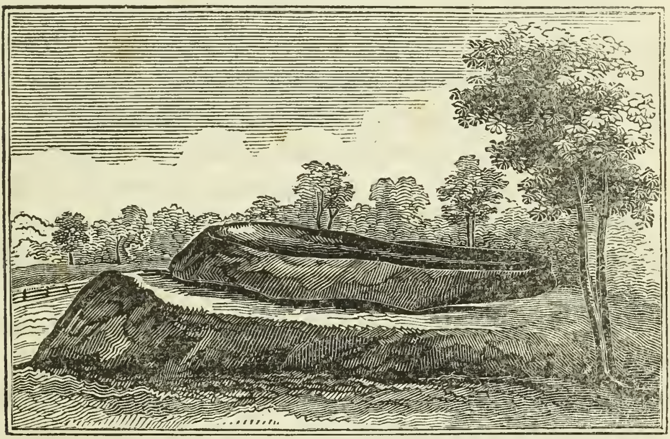
We noticed a number of boulders of magnetic iron ore in the soil, and they are evidently a portion of the diluvial detritus and detached fragments brought by ancient currents from the iron hill in Cumberland. Some of the boulders are two feet in diameter, and are rolled and polished on their surfaces as if from long continued action of water. Thus we see that the diluvial blocks which were derived from Cumberland Hill, are scattered along the shores on both sides of the bay, and in a mean direction south of their parent ledge.

In Apponaug, in the township of Warwick, there is a curious mass of rock delicately balanced upon two points, so as to be moved with great ease by the hand, and as it is said, is even rocked by the wind. When put in motion, it strikes audibly upon its pedestal, and produces a sound similar to the cantering of a horse upon frozen ground. It has received the descriptive appellation of the Drum Rock.

It is situated upon the land of Mr. John Carpenter, three quarters of a mile southwest of the village of Apponaug, just on the edge of a wood lot, and near a spring of good water, said to have been much resorted to by the aboriginal inhabitants. The rock is said to have served the Indians as an alarm or call, for by rocking it a sound is produced audible to a great distance, and I was informed it could be heard during the stillness of night to the distance of six or eight miles.

I measured the dimensions of the rocking stone, and found them to be 7½ feet in length, 5½ in width, and 15 inches in thickness, so it must weigh about 3½ tons. It is composed of compact grau-wacke, and rests upon the same kind of rock, from which it was doubtless separated by the action of frost and by decomposition effected through the medium of a natural fissure.

The following sketch will give an idea of the appearance of the Drum Rock, which is worthy of a visit, and attracts the attention of the curious who travel through the village.



View of Drum Rock, Apponaug.

I examined the estate of Mr. Joseph Harris, on Sockanosset Hill, in Cranston, where some imperfect explorations have been made for coal, to the depth of seven or eight feet. Around these openings I found numerous fragments of slate, graphite, and impure anthracite; but the pits were generally filled with loose stones and soil, so that I could not discover the rocks in place below, but I have no doubt that they belong to the coal formation.

At the homestead of Mr. Harris, I examined a remarkable spring of water, which was in one of his fields, and gives rise to a little rill running through the meadows. Along the banks of this rivulet, and around the spring, clover grows spontaneously and is very luxuriant, while it is wanting in other parts of the field.

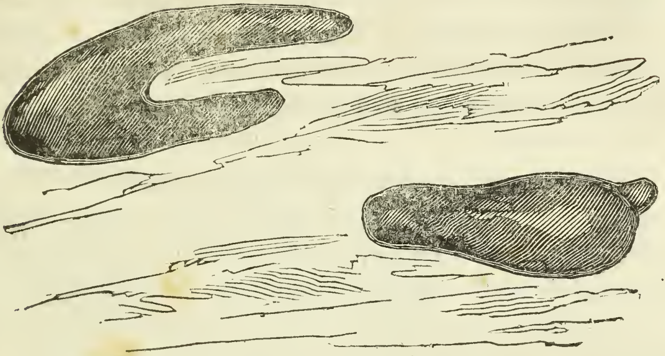
The water I have since analyzed, and find it to contain a great abundance of crenic acid, both in a free state and in combination with per oxide of iron, alumina, and lime. The water also contains a small proportion of the sulphate of lime. A deposit of the per crenate and apocrenate of iron is found in the bottom of the spring and along its course.

Pawtuxet. The rocks in this town are seen to crop out at the falls on the river and below the bridge. They are composed of compact grau-wacke slate, the strata of which run N. and S. and dip to the eastward 30°.

Wickford. The rocks in this village are composed of a peculiar variety of mica slate, formed apparently by the fusion of grau-wacke slate, and are observed to contain fragments and pebbles included or intermixed with their mass.

Near this village, on the road to Kingston, there are some curious erosions on the surface of the rock known by the name of the Devil's Tracks, or foot marks. There is a legend of some notoriety connected with these strange markings, which I shall not here stop to relate, further than to say that the story is that his Satanic Majesty is reported to have carried off a sinful squaw, and to have made his bound from this rock into Purgatory, the prints of the feet of both parties being now pointed out as incontestible evidence of the fact.

The following sketch will show the appearance of two of these imagined foot marks, as they appear on the surface of the ledge, near the road. One has the form of a cloven hoof, and the other has exactly the shape and size of a human foot, even the mark of a great toe being pointed out by the lad who explained to me the story. The steps are three paces apart, and appear thus—



The "Devil's foot marks," near Wickford.

The grau-wacke rocks come in contact with those of the primary class in the neighborhood of Natic village, and the grau-wacke slate passes by insensible shades into mica slate, which rests upon gneiss. A similar metamorphosis of the stratified rocks where they rest on the primary, is observed along their line of junction throughout their borders. Nearly opposite the brick cotton factory, in Natic, upon the road side, there are three large blocks of a peculiar rock composed of a new mineral, associated with mica and garnets. These blocks of stone are erratic, and now rest on a totally dissimilar rock formation.

I have been informed by Professor Hitchcock that the same kind of rock is met with in the town of Ward, in Worcester county, Massachusetts. It is certain that no rock of the kind exists in place in Rhode-Island, and it may appear surprising that those blocks should have been removed so far from their native locality.

I measured one of them and found it to be 15 feet long, 10 feet wide, and 4 feet thick; so that it contains no less than 600 cubic feet; or is about 64 tons in weight. My attention was first called to these rocks by Mr. Owen Mason, in Providence, and I examined them for the purpose of ascertaining the nature of a singular mineral of which they are chiefly composed. This mineral I have analyzed, and find it to constitute an entirely new species, to which I propose giving the name of MASONITE, in honor of one to whom the geology and mineralogy of the State is so much indebted.

Masonite consists of the following ingredients:

Water,	= 4.000	containing	oxigen	3.555 *ratio.*
Silicic acid,	33.200	"	"	17.247=3
Alumina,	29.000	"	"	13.543=2
Magnesia,	0.240	"	"	0.092
Prot-oxide of iron,	25.934	"	"	5.904=1
Ox. of Manganese,	6.000	"	"	1.814
	99.974			

Its mineralogical formula is, $= \left.\begin{matrix} Al^2 \\ fe.\ Mn. \end{matrix}\right\} Si^3 + Aq.$

It is a silicate of alumina and prot-oxide of iron, plus silicate of manganese, plus water. Its specific gravity is = 3.450. It occurs in tabular crystals, which cleave very easily, with brilliant planes perpendicular to their axes, and with great difficulty in the other directions. Its primary appears to be a right rombic prism. It scratches glass, and yields to the knife with difficulty. It is difficultly fusible into a dark green enamel.

Kingston is founded upon a peculiar variety of granite called porphyritic granite-gneiss, in which there are beautiful crystals of felspar, giving it the porphyritic appearance, and adding much to its beauty as a building stone. It is wrought to some extent for the supply of the town and vicinity.

Point Judith. The neck of land whose extremity bears this name, is based entirely upon primary rocks, such as gneiss and granite, forming high ledges along the shore for the distance of several miles.

At the extremity of the point, near the light house, there are beds of blue clay, supposed to be sufficiently refractory for making fire bricks ; but I found upon trial that the clay was readily fused at a full white heat, forming a porous slag of a greenish brown color.

Tracing the rocks along the coast, we found on Mr. E. Potter's farm that there were numerous veins of granite traversing mica slate rocks, and in some cases overlaying them or included between the strata. The mica slate strata run N. 25° E., S. 25° W., and dip S. E. 37°.

At Watson's Pier there are also numerous beds and veins of coarse granite, included between strata of mica slate, rocks, and the strata dip to the S. E. On Boston Neck, opposite Dutch Island light, mica slate rocks are seen running N. and S., and dipping to the eastward 46°.

Tower Hill, in Kingston. Plumbago is found here in several places and has been wrought to some extent for supplying moulding dust for iron founders. Thirty tons of this substance have been raised at one time by digging only four feet into the rocks in the orchard, upon the hill side.

Newport Neck. I examined minutely the rocks along the shore entirely around the coast, and noted some remarkable facts relating to their peculiarities, and their contents. After examining the farm of Mr. N. S. Ruggles, we visited the shore, where beds of blue and white clay are found, which are of good quality for pottery, or for other uses in which a fine plastic clay may be employed. The rocks are clay slate, penetrated by a large vein of quartz, 30 feet wide, which cuts through the strata. The slate runs E. and W. and dips to the S., while the quartz vein runs N. E.

and S. W. and dips 35° to the N. W. Proceeding southwardly, we next came to slate strata running N. 30° E., S. 30° W., and inclining to the N. W. by W. 50 or 51°. We then came to numerous small beds of anthracite, varying from one foot to three feet in width, and presenting their outcropping ends and edges to the sea. The coal is contained as usual in a highly carbonaceous clay slate, impressed with myriads of fossil plants peculiar to the coal bearing strata. Nodules of clay iron stone, containing beautiful crystals of iron pyrites, also abound, and are found in kidney shaped masses in the slate rocks. Tracing the rocks along we came next to a diluvial soil, and then the strata of rocks appear again, and soon evince the action of igneous disturbing causes, for first we note a change in the color of the rock, where it is converted into a more compact and greyish slate, it then becomes a flinty slate, and at its junction with the granite, a complete fusion and scorification have evidently taken place, and the strata are tilted up, and reversed in their dip. Many of the semifused stratified rocks are blown into a sort of scoria, and the cavities are lined with a glazing of bright green epidote, a result of igneous fusion.

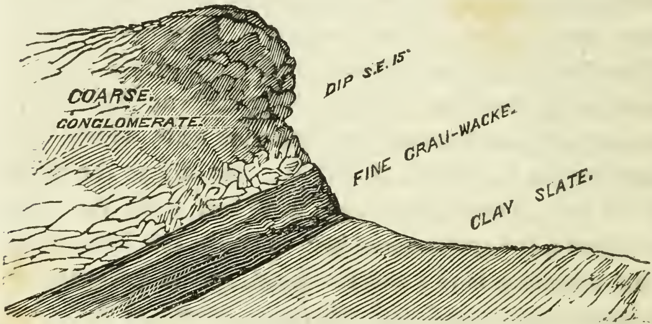
The granite appears bursting through the slate strata at Rough Point, and the line of fracture runs nearly east and west, across the neck. A sectional measurement was made along the shore for the purpose of ascertaining the extent of the igneous disturbance of the strata. The distances were 496 feet to the slate, 1122 feet to Sheep Point, thence 462 feet to the coal bearing slates. I then followed the shore northwardly to Ochre Point, where yellow ochreous oxide of iron abounds and has been wrought to a limited extent for paint. The mass of granite, altered slates, and porphyritic rocks, found on the rocky land at the Point, show clearly the appearances usually presented by intruded molten rocks, and the flinty slate so abundant there is an altered clay slate, semifused by the action of the intruded granite. The serpentine beds at Willow Grove, near Fort Adams, are also intruded beds, having been produced by igneous fusion, and by eruption from below. The same kind of rocks are found on Connanicut Island, where we see the granite again protruding through and altering the appearance of the slate rocks, and it will be remarked that where the slate approaches, and rests upon the granite, it always presents the appearance of fusion. Thus on each side of the Dumpling Rocks, which are granite, the slate will be found to show these metamorphoses.

At Fort Adams, in Newport Harbor, we again see the outcroppings of the altered slate rocks, and, imbedded in their strata, occur several important beds of limestone. The slate within the fortress, beneath the parade ground, is distinctly stratified, and dips to the eastward 15°. Near the fort on the shore are the limestone beds, which were found to run N. 50° E., S. 50° W., and dip to the S. E. 40° or 50°. One of these beds is 45 feet wide, the other is 15 feet ; the easternmost bed contains the lime rocks. This limestone is of a compact kind, and is variegated in its color, being tinged with red, green, brown, or buff color, by the presence of variable proportions of foreign matters, principally oxides of manganese and iron. There are evident appearances of mechanical and chemical disturbance, in this rock, for the limestone is broken up, and again united into a breccia, and frequently includes fragments of the slate strata. Numerous veins of quartz traverse the limestone and slate, checking it up in a curious manner, and presenting the quartz in relief, where the softer rocks have been worn away by the action of the water.

I visited and examined the Lime Islands which lie west from the Coddington factories, and east of the fortification.

The larger of these islands is 210 feet long, and 90 feet wide, along the sea line, the other is about half of the above dimensions, and is ten feet high above the tide waters. It is well known that the cement, made from these rocks, is remarkably durable, and that it is somewhat hydraulic in its nature. It has been used advantageously by Colonel Totten, in the construction of the neighboring fortification. (See chemical analysis of these limestones.)

Miantonomah Hill. This eminence presents a very distinct view of the relative position of the coarse and fine grained conglomerate rocks, the former occupying the upper place in the series, and resting on the latter, while the clay slate occupies the slope below.



Sectional View of Miantonomah Hill, near Newport.

The coarse conglomerate is composed of rounded and oval-shaped pebbles, cemented by a paste of the more finely comminuted particles, indurated by pressure and perhaps by heat.

The fine grau-wacke is merely a more finely divided sediment, indurated by similar means. The slate was once clay, but is now hardened into stratified rock. The whole mass has been tilted up, probably, by subterranean fire.

Miantonomah Hill is a place of historical interest, and will be visited by the curious, on account of the ancient fortifications, or breastworks, which were thrown up on its summit, and still remain as interesting relics of the wars with Great Britain. During the Revolutionary War the British possessed themselves of these heights, and their ordnance, from so commanding a situation, covered effectually the disembarkment of their troops.

Purgatory, and the Hanging Rocks of Paradise, are examples of geological importance, as showing the effects of aqueous action. At Purgatory we see a very hard and finely cemented mass of conglomerated pebbles, varying in size, from an inch to a yard in length, and all oval shaped, with their long axes parallel to each other as if affected by a powerful current, or the surf of a former ocean. These pebbles are of the hardest kind of quartz rock, and yet present polished surfaces, evidently the result of long abrasion, produced by friction upon each other, effected by the action of water. Now we find the pebbles cemented together, by a finer paste, of a similar nature, but presenting all the usual appearances of fusion. I remarked also an infinity of minute crystals of magnetic iron ore on their surfaces, and in many cases that substance served to attach the pebbles to each other. Magnetic oxide of iron could never have been deposited in that state from water, and I regard it as an absolute proof of the agency of fire, which has fused the cement and crystallized the oxide of iron.

By means of a simple lens, or common microscope, any person may discover a great abundance of these Magnetic crystals, and even to the naked eye, when the sun shines upon the rock, they are very apparent. The chasm called Purgatory, is a fissure, in the conglomerate rock, produced by an ancient disruption of the strata, and was once filled by a dyke of greenstone trap, which has been worn away by decomposition and by the mechanical action of the sea below ; a small portion only remaining, in the south end of the rent, to attest its former presence. This rent is in a S. E. and N. W. direction, and by measurement, was found to be of the following dimensions: The width was from 8 to 10 feet, the depth is 36 feet on one side, and 44 feet on the opposite or highest point. The pebbles are arranged in parallel directions, their long axes coinciding and running north and south. They consist of very hard quartz rock and flinty slate, and the pebbles have been cut in two by the power that up-hove the rock.

Purgatory is a place of resort for the curious, and a singular legend is connected with the name which it bears. It is said that a young man being challenged to prove his love for a fair maiden, actually sprang across this ravine, and declared his transit as one from Purgatory to Paradise; hence the origin of the names by which these localities are known.

The hanging rocks are merely huge masses of stratified conglomerate rocks, which present abrupt and mural precipices towards the sea, and in some points of view appear to overhang the shore. The white sandy beaches which here form a barrier to the wild ocean's waves, are frequented by strangers and by the people, for the sake of the grandeur of the scenery, and in pleasant weather they present suitable places for sea bathing, and afford a delightful ride. Much as I might wish to expatiate on the beauty and interest of these places, I feel that I ought not to spare time from my more serious duties in describing the geological contour of the country. The central portions of the island are composed of slate rock, and they are here and there charged with beds of anthracite. Several small seams have been found at Newport, which are probably a continuation of those observed at Sheep Point, on the neck before described. On Quaker Hill a small coal bed was struck many years ago, but was not wrought. Lawton's Valley exhibits the clay slate without any coal beds.

The rocks there are precipitous, and are crowned on their summits with a rich natural foliage, and a picturesque effect is produced by a small stream, winding through the vale, amid rocks and shrubbery. It is a place of frequent resort during the summer months.

Butts Hill, in Portsmouth, is the site of ancient fortifications, and a place of historical interest. To the Geologist it presents a mass of stratified rocks, alternating with and overlaying the slates of the coal measures. The strata dip towards each other from each side of this eminence, as seen in our section across the island, from Cases' coal mine on the east, to the old Portsmouth mine on the west.

In the town of Portsmouth, at the northern extremity of the island, several beds of anthracite occur, included between the beds of carbonaceous slate, subordinate to the fine grau-wacke rocks. In former years, before the use of hard coal was fully understood, mines were opened for the purpose of extracting this coal, but after a few years of unprofitable labor the mines were abandoned by the company, and have since remained neglected.

I found it impossible to obtain any accurate statistics respecting the causes of failure in these explorations, and am informed that the books and papers of the company were destroyed by the great fire in the city of New-York. A gentleman in Newport, familiar with the business, informed me that upwards of $40,000 had been expended and that the works were given up about fifteen years since. The coal beds were stated to be three in number, and varied from two to twelve feet in thickness, being quite irregular. Perpendicular shafts, and horizontal galleries, were excavated, while a steam engine, with endless chain gear, was used in clearing the mine of water, the extra power being used in raising the coal.

I visited and examined very minutely this coal formation, measuring with care the height and relative position of every accessible bed, and made also a sectional profile of the rocks across the island. One of the coal beds has been wrought at its outcropping edges, and there the situation of the coal can be easily determined. The excavation slopes with the strata of slate S. 50° E. and at an angle of from 28° to 30°.

Portsmouth Coal Mines.

This coal bed is fifteen feet below the surface soil, and is included immediately between walls of carboniferous slate or anthracite shale, containing numerous impressions of the usual coal plants. See wood cuts of these fossils.

I descended into the sloping shaft of this mine, measured the thickness of the bed, and obtained specimens of the coal for chemical examination. The bed measures three feet in thickness, from the wall to the floor, perpendicularly to the strata.

The coal is free from layers of slate, and is very curiously checked by natural joints leading to a rhomboidal structure, this being the result apparently of an imperfect crystallization effected by heat at the epoch of its elevation from a horizontal position. Masses of coal of considerable magnitude may be easily broken off, but they divide readily into rhomboids an inch or two in diameter. The chemical analysis of two varieties of the coal from this bed gave the following results :

No. 1. A clean solid specimen free from rust.

Water and volatile matter,	10.0
Carbon,	84.5
Ashes (of a dark red color,)	5.5
	100.0

No. 2. A specimen of the rusty coal.

Water and volatile matter,	7.0
Carbon,	77.0
Ashes (dark purple red,)	16.0
	100.0

The ashes from No. 2 consists of silex	7.4
Oxide of iron, alumina, manganese, and a little lime,	8.0
	15.4

It is evident from the composition of this coal that it will burn freely, and since small coals are now valued for manufacturing establishments and are easily burned by the improved furnaces, it will find a ready market.

There are four ancient openings near each other upon the old Portsmouth coal company's lot, the bearings of which are as follows: From the sloping shaft mine, (the southernmost of the old excavations,) the next pit bears N. 22° E. and is 388 feet distant. Proceeding to the latter, we took the bearings of the others, the next being to the N. 68° E., 375 feet distant, and another N. 81° E., 279 feet.

There are at least four distinct beds of coal at this place, most of which are of sufficient magnitude to be advantageously wrought.

Some new explorations were making at the time of my second visit to these mines, Mr. Speiker, a Hessian, having been employed by a New-York company to bore into the rocky strata either for the purpose of finding the old beds without the limits of the former company's purchase, or to discover new beds of coal. This gentleman ranged the old pits in the line of bearing of the strata, and bored with the augur and drill in numerous places in those directions. While searching for the southern bed he struck upon one which is nearly on a line with it, but is much wider. This opening bears S. 39° W. from the old sloping shaft, and is 448 feet distant from it.

Since the above remarks were made I have had an opportunity of revisiting the locality in question, and have obtained additional information of importance, which I shall here communicate.

April 7, 1840, I revisited the Portsmouth coal mines, in company with Mr. Christopher Rhodes and his son, for the purpose of examining the extent of the new bed of coal opened by the Rhode-Island coal company. On descending into the mine I measured the thickness of the coal bed, and found that it was 12 feet in thickness at its centre, and from 7 1-2 to 8 feet in the north and south levels, the bed swelling out at its centre and contracting at the two extremes of the mine. There are three different varieties of coal raised, the best kind being that which is impregnated at its natural joints with per oxide of iron and manganese, while the glossy and greyish black masses are more charged with argillaceous matter, and decrepitate violently when thrown on the fire.

The coal is easily blasted out in large masses, and it is sufficiently solid to bear distant transportation. I selected specimens of all the different varieties of the coal, and having submitted them to a rigid chemical analysis, have obtained the following results.

No. 1. Rusty coal, said to be of the best quality. It is crystalline in its structure, breaking into rhomboidal fragments whose surfaces are covered with per oxide of iron. It is, however, sufficiently coherent to bear transportation without crumbling, and when broken separates into large pieces suitable for the grate.

Its specific gravity was taken, the barometer standing at 30 inches, and the distilled water being at the temperature of 60° F. Spe-cific gravity = 1.850, water being 1. Hence a cubic yard of the coal will weigh 3021.2 lbs. or tons 1.5106.

Six hundred grains of the coal burned in a muffle on a sheet of platina, yielded 23 grains of dark purplish red ashes, = 3.23⅓ per cent. The ashes being analyzed gave the following results :

Silex,	2.0	or per cent	0.333
Alumina,	1.4		0.233
Per ox. iron,	12.3		2.050
Manganese,	2.3		0.666
Lime,	2.25		0.376
	20.25		3.658
	2.75	loss—Manganese.	
	23.00		

Two hundred grains of the coal, heated to low redness in a closely covered counterpoised platina crucible, lost 21 grains of water and gaseous matter, equal to 10.5 per cent. The coal recently from the mine yields then the following results, per cent.

Water and volatile matter,	10.50
Carbon,	85.84
Ashes,	3.66
Sulphur, a trace	
	100.00

In order to determine more accurately the water and gaseous matter, I made a small green glass tube retort, and having weighed in 50 grains of the coal, after it had been thoroughly dried by a month's exposure in a warm room. To this a counterpoised tube filled with fused chloride of calcium was attached to absorb the moisture, and from the other extremity a small glass tube allowed the escape of the gaseous matter. The little retort being heated to full redness for an hour lost 5 grains, equal to 10 per cent. The chloride of calcium gained 4.2 grains, equal to 8.4 per cent—difference 1.6 per cent of matter expelled in the form of gas. Owing to the presence of so large a proportion of water the coal burns with a flame ; the water, of composition is decomposed during combustion, and carburetted hydrogen and carbonic oxide are produced; the former gas burns with a yellow and the latter with a blue flame.

No. 2. This coal appears to be of good quality, is solid, greyish black and glossy, but not plumbaginous.

When thrown on the fire it decrepitates, violently throwing off fragments in great profusion.

Its specific gravity is 1.7704, water being 1.

It weighs 2986.74 lbs. to the cubic yard or 1.493 tons.

100 grains of the coal analyzed yielded

Water and gazeous matter	= 13.00
Carbon	77.50
Ashes (of a greyish color)	9.50
	100.00

The ashes is composed of silex	= 4.20
Alumina manganese and per oxide of iron	5.00
Lime	0.30
	9.50

This coal will answer for furnaces and for cylinder stoves, but not for parlor grates. It is evident from their composition, that the ashes of all these coals will form slags or clinkers when exposed to a very high temperature.

For the sake of comparison I analyzed a fair specimen of the coal which I obtained from the Mansfield coal mines at the Skinner bed. Its specific gravity is = 1.690. It weighs 2875.5 lbs. to the cubic yard, or 1.4327 tons. On chemical analysis of 100 grains, I obtained,

Water and volatile matter,	= 6.2
Carbon,	87.4
Ashes,	6.4
	100.0

The Lackawana coal was also compared, and a compact specimen of the best coal had a specific gravity of 1.609, and a cubic yard of it will weigh 2700.8 lbs., or 1.3504 tons. Mr. Christopher Rhodes, Jun., weighed a lot of Lackawana coal amounting to 33,477 lbs., and having burned it obtained 2,566 lbs. of ashes, or 7.2-3 per cent. He has also burned 8705 lbs. of coal from the new Portsmouth mine, and obtained 1332 lbs. of ashes, or 15.3 per cent. The coal was not selected as the best, but was considered a fair merchantable lot. He has also repeated his trial of the Lackawana coal, and having burned 32,344 lbs. of it, obtained 2489 lbs. of ashes, or 7.69 per cent. A specimen of this coal, analyzed by me in 1836, gave

9.2	per cent of water.
11.6	white ashes.
79.2	carbon.
100.0	

This variety had a specific gravity of 1.4530, and the cubic yard weighed 2451.9-10 lbs. or 1,4530 tons.

The following table indicates the specific gravities and weight of the cubic yard of various coals, as determined in my laboratory in 1836.

Anthracites.

	Spec. Gravity.	Weight of Cubic yd.	Water and vol. matter, per cent.
Lackawana,	1.4530	$2551\frac{9}{10}$ lbs.	9.2
Peach Orchard,	1.5327	$2585\frac{2}{5}$ “	6.6
Black Heath,	1.5354	$2590\frac{9}{10}$	not ascertained
Peach Mountain,	1.5695	$2648\frac{1}{2}$ “	7.2
Belmont,	1.5816	$2668\frac{9}{10}$ “	6.6
Broad Mountain,	1.5938	$2689\frac{1}{2}$ “	7.8
Gate Vein,	1.6094	$2715\frac{4}{5}$ “	6.6
Mansfield, Hardon's,	1.7100	$2885\frac{5}{8}$ “	6.0

Bituminous Coals.

Cannel of Kentucky,	1.2500	$2109\frac{3}{10}$
“ “ England,	1.2720	$2146\frac{1}{2}$
Orrel Coal,	1.2790	$2158\frac{1}{10}$
Newcastle,	1.3200	$2227\frac{1}{2}$
Frostberg, Maryland,	1.3210	$2227\frac{1}{10}$

These tables may prove serviceable to manufacturers, and to others who consume coals extensively.

When we know the weight of a cubic yard of coal, it is easy, by measuring the number of cubic yards in the bed, to calculate the number of tons of coal contained in it approximatively.

At Portsmouth we can form only a rough estimate, because of the irregularity of the expansions and contractions of the beds, which cannot be certainly known, since the out-croppings are not yet sufficiently exposed. It is evident that there is an ample supply for the citizens of Rhode-Island for many years, and with the continuance of mining operations, new beds will be opened that are as yet concealed from view by the superficial soil. In estimating the coal, we must calculate how far it will be practicable for the miners to work, the expense of drainage, &c. The amount of poor coals, and the coal dust and small skreenings must also be deducted. After all these calculations, I feel no doubt that any reasonable man will be satisfied that there is a most valuable supply of coal, that may be economically raised, at the Portsmouth mines. We must not place any value on the opinions formerly entertained as to the difficulty of burning this kind of coal, for the people of New-England did not then understand the art of burning anthracite. Now it is found that even the refuse skreening of the old abandoned mines can be easily burnt, and several hands are constantly employed in sifting the heaps of refuse for that purpose, the skreened small coal selling readily at from $2 to $3 per ton. There cannot be a doubt that a ready market will be found for all the coal that may be raised from these mines.

We may safely estimate the present new bed at 2 yards in thickness, for the distance of 300 or 400 yards northwardly or southwardly; but whether the thickness will prove uniform as we descend, experience at those mines has not yet decided. Supposing that there are only three beds of coal at Portsmouth, and that they will average but one yard in thickness, and that owing to waste and impurities, a cubic yard would furnish only one ton of merchantable coal. Let us estimate the length of the beds at 3000 yards, and the depth to which they may be wrought at 100 yards, and three beds at one yard in thickness each ; and we shall have 900,000 tons of coal for the contents of the three beds on one side of the island within the above limits, and since the coal forms a basin, it is evident that the same amount of coal may be obtained on its other side. (See sectional view of the strata.)

The actual width of this basin, from the Portsmouth company's mines to Case's mine, is 8000 feet, and the coal has been traced northwardly nearly to Bristol ferry, or to the distance of one mile and three quarters.

From the dip of the beds of coal on each side of the island, it is evident that the centre of the basin, is not less than 1,200 feet below the surface at Butts' Hill, and it is not probable that miners will succeed in reaching that depth in excavating the coal. If we estimate the probable contents of one of these beds at 3000 yards long, and 2800 yards wide, and one yard thick, we shall have 8,400,000 cubic yards as the contents, and as there are three beds at least of those dimensions, the amount of coal will be 25,200,000 cubic yards, and the cubic yard weighing 1 1-2 tons, the coal will amount to 37,800,000 tons within the limits estimated. It is not improbable that there are still other beds of coal alternating with those already discovered, and if the present company continue to raise the coal economically, it will serve to stimulate a more extended search. It is difficult to give any thing more than this rough estimate before mining operations shall have exposed the various beds to view. The above may serve as an example or formula for the measurement of each bed that may be opened. Mr. Randolph, of Newport, says that the old Portsmouth Company bored through three successive coal beds, which were of variable thickness.

Crossing the island, we examined Butts' Hill, where (in the ditch of the old fortification) may be seen the slate rocks belonging to the coal formation, but they are not charged with carbon. The strata dip west 15° and run north and south. On the eastern side of the hill we came to the old coal-pits sunk by Dr. Case, and still known by his name ; these mine were wrought about fifteen or twenty years since, and have been abandoned ; they were not managed skilfully, and one man was killed by the falling in of the roof of the mine. At Case's mine the strata of rock and the coal bed dip to the W. N. W. 15° to 20°. It is evident that the strata form an irregular trough or basin, the coal running N. N. E., S. S. W., and dipping under Butts' Hill, and rising again at the old Portsmouth mines, on the western shore of the island.

The land at Case's mine is 75 feet above high water mark, and drainage to that extent may be easily effected. The soil is said to be from 10 to 30 feet deep over the rock which contains the coal. A number of openings have been made at this place, and by these I was enabled to get a correct plan of the strata, and thus to show the structure of this part of the island.

Crossing the ferry at Bristol, we noted the granite on the eastern side of the promontory, where it rises through the grauwacke rocks, but the line of junction is not visible, owing to the superficial covering of soil. Professor D'Wolf says, that wells have been sunk in Bristol, until the granite was struck beneath the grauwacke, hence there can be no doubt that the granite rocks underlay the coal formation.

On Pappoose-squaws neck, we examined the fine hard grauwacke, which dips to the east by north 20°, and is a fine building stone, and affords a good site for opening an extensive quarry. On the surface of the ledge there are distinct diluvial scratches, which run N. 5° E., S. 5° W., and on the most abrupt slope of the hill, the scratches are gently curved downwards, as if the two forces, gravity and impulse, had acted upon the boulders, which formed the scratches. On the shore, many rounded and polished boulders of the Cumberland porphyritic iron ore, occur, varying in size from a few inches to a foot or more in diameter. These appear to have been washed out from the soil. At Bristol Neck, on the estate of Mr. Peter Church, the slate rocks occur which usually accompany coal, and contain an abundance of fossil plants. At that place the strata all dip in towards the land, or N. E. 20° to 30°.

The slate is seen to dip under a very fine and hard compact grau-wacke, which is quarried for building stone, and may be traced to the north-eastward of the slate, about half a mile.

I obtained specimens of all the fossil plants, but could not discover any bed of coal at this place. The fine compact grau-wacke is almost as solid as granite, and has been quarried to some extent. The oil factory at Bristol is constructed of this rock. I visited Warren Neck, where there is nothing peculiar in the rocks, but the soil is quite good, and is advantageously cultivated. This soil is underlaid by a hard pan of blue clay about two feet below the surface, which causes the soil to retain the moisture and soluble manures.

Mansfield Coal Mines in Massachusetts.

In the month of October, 1835, a small seam of anthracite was accidentally discovered in Mansfield, Massachusetts, by Mr. Alfred Hardon, while engaged in sinking a well near his house, and the fact having been noticed in the newspapers, Mr. William Coolidge, of Portland, in company with several merchants of Boston, visited the locality, and obtained leases, with the right of mining on numerous farms in the vicinity. Subsequently I was invited to visit the locality, and there made accurate measurements of the direction of the strata, and the dip, direction, and dimensions of the bed, but was of opinion that the coal, being only eighteen inches thick, was not worth extracting, and consequently it was abandoned, and the well was stoned up. I then made careful inquiry as to the matters found in digging various wells in the town, and examined the rocks wherever they appeared above the surface of the soil, for the purpose of ascertaining whether there was any reason to suppose larger beds of coal occurred in them. The result was, that evidence existed of the occurrence of numerous other similar deposits which were thicker than the one first discovered, and hence I advised search to be made, having marked upon a map of the town the position of five distinct coal beds, in lines parallel with the strata.

In each case where I had marked the location of a coal bed, subsequent mining operations discovered them, and some were found to be five feet or more thick, and their linear extent is not less than one mile, within the limits of my examination, and they probably extend much farther. The strata between which the coal beds are included run quite uniformly E. N. E., W. S. W., and dip to the N. N. W. 52°. Abundant impressions of ferns, calamites, stigmariæ, and other coal plants, also occur, imprinted on the slates containing coal, so that I was enabled to discover no less than fourteen species of fossil plants during my three visits to the mines.

The evidence in favor of workable beds of coal in this town was deemed sufficiently conclusive to authorise the sinking of shafts for the purpose of obtaining it, but much difficulty was anticipated on account of the water which abounds beneath the soil of the plain, it being copiously supplied by the low surrounding hills.

This proved to be the chief obstacle to the mining operations that were subsequently carried on, but it is one which a skilful mining engineer can overcome, by building a water tight curb from the surface of the rock to the top soil, consisting of brick laid in Roman cement.

Should operations be carried on by experienced miners, I have no doubt that large quantities of valuable coal might be raised in this town, and it is probable that operations will be resumed there ere long.

In October, 1835, I made chemical analysis of the Mansfield coal with the following results :—

No. 1, specific gravity = 1.71, weight of cubic yard, 2883.1 lbs.

No. 2, " " = 1.73, " " " 2934.9 lbs.

100 grains dried at a temperature below ignition, lost 6 grains of water.

100 grains of the best dry coal analyzed, gave the following results :—

No. 1, Carbon	98	No. 2, Carbon	96
Ashes	= 2	Ashes	4
	100		100

And the coal consists of

Water	6	Water	6
Carbon	= 92	Carbon	90
Ashes	2	Ashes	4
	100		100

It burns well, leaving but little ashes.

From want of experience in mining, the company first engaged in working the Mansfield mines failed to make the business profitable, and the mines were abandoned in 1838. I was informed by one of the proprietors that they raised about 2000 tons of merchantable coal, and that it sold readily at nearly the same price as was paid for the Pennsylvania anthracite.

During the present survey, I revisited the Mansfield mines, and examined their condition. There are three openings, which appeared to have furnished a good supply of coal, and at Alfred Hardon's there was about 200 tons of it upon the ground, one half of which was estimated to be merchantable. This mine has a shaft 64 feet deep, and at the bottom is a gallery extending 40 feet south-eastwardly or across the line of stratification. This gallery cuts across three or four beds of coal, the widest of which was five feet in thickness, and is of good quality. It was found that the beds, as I had predicted, widened to the south-eastward, or lower in the series.

On the estate of the late Otis Skinner, situated half a mile north-westward from Hardon's, a mine has also been opened, and has furnished a large quantity of excellent coal. The shaft of this mine is 85 feet deep, and a good high-pressure engine with a horizontal cylinder still remains in the top house, and was formerly used to drain the water from the mine. I obtained a quantity of the coal, and since have burned some of it in a stove, and found it to be of very good quality. The bed last struck, in this mine, is said to have been seven feet thick, and the coal was good, burning freely, and yielding but $6\frac{1}{10}$ per cent of ashes.

On the Harris estate, a shaft has also been sunk, as I was informed, to the depth of 100 feet, and a drift was cut in a N. N. W. and S. S. E. direction. A bed of coal was struck 17 feet from the surface, but it was found to have been altered, and was like graphite or plumbago.

I inquired very minutely into the history of the workings at the Mansfield mines, and was informed that the miners on some days raised 10 tons of coal, while on others they obtained but little. The actual cost of extracting the coal and raising it to the surface, was but $1,00 per ton after gaining access to the bed. From the facts which I have been able to glean, it appeared to me that there were no insurmountable obstacles to the working of the Mansfield mines, and if pursued with skill and economy, it could not fail to become a profitable business.

These mines being situated near the rail-road, and but 15 miles from Providence, will become of commercial importance to Rhode-Island, and I hope, if neglected by the present proprietors, they will meet with due attention from the manufacturers in this State.

Several narrow beds of coal have also been found in Wrentham, and it was hoped, as the ground was more elevated than at Mansfield, that some of them might be worthy of exploration. I therefore visited every spot where any indications of coal were found, but none of the beds were of sufficient width to warrant mining, and they have all been abandoned. Some useful information respecting the order of strata in this formation was obtained on our visit to this town, and it was clearly seen that the slate forms alternating strata, with the fine conglomerate, or grau-wacke.

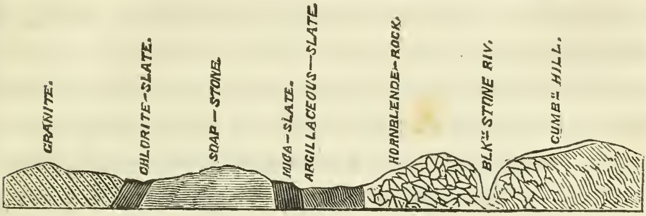
A moderate ridge of rocky land here presents itself, composed of alternating strata of conglomerate or slate rocks, and in the latter, near the house of Mr. Hancock, several seams of highly plumbaginous coal were discovered. In some of the places the coal was found by boring with the artisian auger, and drills, in others by sinking shafts through the soil, which is 15 feet thick. One of the vertical shafts penetrated 60 feet into the slate rocks, coal was found mixed with much slate, and with numerous veins of quartz.

Two and a half miles west from Mr. Hancock's, a narrow bed of coal was struck in digging a well.

This bed was stated to be only six inches wide, but was of good quality. The well was sunk to the depth of 22 feet, and penetrated the rock about 16 feet. The strata dip westward and run north and south. On examining the fragments of slate around this well, impressions of ferns were found, and the slate was highly charged with carbonaceous matter. In the grau-wacke near this place, a large fossil plant was discovered, curved in a circular form, and was supposed by the people to be a petrified serpent. On examining the locality, I was enabled to obtain a few pieces of this fossil, and satisfied myself that it was the stem of a large stigmaria.

Many fine impressions of the fronds of ferns were found at this locality, in the slate rocks which are colored black by carbon. After a careful search, we were satisfied that none of the coal beds on this hill could be advantageously wrought. Taking the bearing of the coal mines of Mansfield from this place, it appeared that they would not strike this hill, but must run to the south of it, and consequently will continue in the lower land, where the same difficulties in drainage will also occur. Mansfield meeting-house is five miles distant, and bears east from Hancock's Hill, and is 13′ below a horizontal line drawn from the summit of this hill. From Wrentham we traced the grau-wacke rocks to Cumberland, and ascertained that they give way to granite about two miles from Mason's Tavern. I re-examined this town as minutely as possible, traced all the most important rocks, and minerals, and measured the height of every spot of interest. I visited Woonsocket, and continued my explorations there, and then returned to Smithfield, making a sectional view of the route from this place to Providence ; and also another section from Diamond Hill to Providence. (See sectional views.)

A cross section was also made from Smithfield to Cumberland Hill, and that portion of the country was examined as minutely as practicable. See wood cut.



Sectional profile of the Rocks from Smithfield to Cumberland Hill.

Block-Island, or New-Shoreham.

I visited this lone island of the ocean, for the purpose of examining its geological and agricultural character. It is situated about 25 miles S. S. W. from Newport, and 15 miles from Point Judith.

There is no harbor on its shores in which any decked vessel can safely ride, at all times, and hence open sail boats alone are employed by the islanders, who are very skilful boatmen, and rarely suffer from accidents during their frequent voyages across the waters to Newport.

We took passage in the mail boat, at six o'clock in the evening of the 19th of October, and after beating against a head wind, in the midst of a rain storm, all night, landed safely, although drenched with water, at six the next morning, and took lodgings with Mr. Jeremiah Clarke, near Sands' Landing.

The storm continued the next day, and all the boats were drawn up on the shore to prevent their destruction by the violence of the surf. The only protection afforded to the boats at the landing, consists of long poles driven into the sand, and this serves to break the violence of the waves, while at the same time the upright poles to which the boats are loosely fastened, allow them to rise and fall with the waves, without being driven from their moorings. This affords sufficient security so long as the weather is moderate, but when the wind blows in from the S. E. it is necessary to haul the boats up on the shore, which is done by means of oxen attached to a tackle.

It is highly desirable for the security of vessels that a breakwater should be constructed at this landing, and it may be easily effected in a substantial manner by making a stone pier 600 yards in length, so as to form a curve capable of protecting the vessels which lie within it. The water at the place proposed is but 20 feet deep, and there are loose granite rocks enough in the immediate vicinity for the construction of the work. The mean rise of tide at the place is 3 feet, and the highest tides rise about 6 feet.

When we consider the population of the island and the value of its industrial products, it will be seen that a breakwater affording protection to decked vessels is a most important desideratum, and one which ought to receive the immediate attention of the state and of the general government; since it will in no small degree advance the prosperity of the island, by affording facilities to its commerce, and will render navigation great services, by affording a safe harbor to fishing vessels and coasters that may require such protection, in case they are exposed to stormy weather while on this coast.

The population of Block Island at the last census was 1200 souls, and now is said to amount to about 1300. A large proportion of the inhabitants are engaged in rural occupations, while the remainder pursue the business of fishing. There are few country towns of the same area, having so large a population as this island, and its agricultural and commercial prosperity is certainly worthy of serious attention.

I made inquiry concerning the value of the fisheries, and found that the quantity of fish caught amounted to 2000 quintals per annum. No bounty is allowed for fish caught in vessels of less than four tons, and here only open boats can be used, since they must be light enough to haul up on shore to save them from destruction by the surf, a large amount of premium is thus lost to the people, and consequently, to the State. The bounty allowed by the United States government is $4,00 per ton on fishing vessels; and if decked schooners could be employed here, the people would engage largely in the business, and more than twice the number of fish might be caught.

It is more difficult to estimate the value of the agricultural products of Block Island, but after examining many of the farms, and making inquiries of the best farmers, I am satisfied that the land produces nearly as much per acre as the soil of the island of Rhode-Island. By judicious management, taking advantage of the refuse peat in making compost manures, I have no doubt the agricultural products may be soon doubled in amount. It is commonly supposed that the population of Block Island consists entirely of fishermen, but this is by no means the case; and by inquiring among the people I found a very large majority of them to be farmers, and some of the islanders never go upon the sea excepting when business calls them to visit the main land.

Soon as the weather permitted, I made a tour around the shores of the island, and afterwards crossed over every farm in the interior, examining first its geological structure and then its agricultural resources. I had occasion frequently to stop at the houses of the inhabitants, and was every where received with kindness and hospitality.

After obtaining such information on the subjects proposed, as practicable, I made a survey of the island, by means of a pocket sextant and compass, taking advantage of the signal staves erected by the United States' Coast Surveyors for the purpose of triangulation. Hence, our plan will be found more correct than any one hitherto published. Our base line was measured from Pilot to Beacon Hill, 2 miles 210 feet, and angles were taken at each signal-staff, and are accurate to one minute of a degree.

Block Island presents an irregular rolling surface of hills and valleys of gentle undulation, the hills rarely attaining more than 150 feet above the sea level, while the valleys are rounded basins, frequently filled with excellent peat, of greater or less depth. The surface soil is entirely of granitic origin, and contains numerous boulders of granite, identical with that found in place at Point Judith and Kingston, while the substratum on which the whole rests, is a deposit of tertiary blue clay, containing imbedded masses of gravelly bog iron ore.

No rocks are found in place on the island, and the loose masses are undoubtedly of diluvial origin, and were transported by the agency of water or ice from the main land at Kingston. This must have been the case, for even should there be a granitic nucleus to the island, there is no conceivable way in which detached blocks of its lower ledges could have been deposited on top of the thick beds of tertiary clay that cover them.

Moreover, we know the Kingston granite by its peculiar porphyritic structure, and by its general appearance. It may surprise some persons when they learn that innumerable blocks of granite, weighing many tons, have actually made a voyage from the shores of Kingston to the interior of Block Island; but such is undoubtedly the fact.

The tertiary clay of this island, like other similar deposits in the state, is destitute of any remains of marine shells, for after diligent search, I was unable to find any trace of them.

The clay is remarkably plastic, and is suitable for making bricks, and in some places will serve for ordinary pottery. It contains alternate beds of white sand, but they are of comparatively small dimensions. Bog iron occurs mixed with gravel at the southern extremity of the island, and also in less quantity at Clay Head, on its north-eastern side. At Clay Head the strata of clay are wavey, and dip generally to the N. W.

The bog iron is in strata about one foot in thickness, but is too gravelly for economical use. The clay cliff rises from 40 to 60 feet perpendicular elevation, and the top is crowned with diluvial soil, while the shore is strewed with myriads of huge blocks of granite, that have been washed from the soil by the action of the sea.

At the south western end of the island I visited Mr. Sheffield, and was accompanied by him to the clay cliffs, which border the shores of his farm. The cliffs were there found to be very high and precipitous, rising from 70 to 100 feet perpendicularly, or with a very steep slope. The clay is of the blue variety, and destitute of marine shells, but is interstratified with beds of gravelly bog iron ore, measuring from 3 to 7 feet in thickness. The strata slope to the N. W. 20°.

Huge blocks of granite, both rounded and angular, are scattered profusely upon the shore, and serve to arrest the degrading of the cliffs, by breaking the force of the surf that rolls upon the shore, during storms, with great fury.

Owing to the continual friction to which the loose stones are exposed by the regular action of the waves, they soon become rounded or oval, and are much sought for to be used as paving stones, large cargoes being frequently taken away to furnish pavements for the streets of New-York. The town of New-Shoreham owns the privilege and sells the right of obtaining them. I should, however, consider it ruinous policy to allow their removal, for they constitute an important barrier against the encroachments of the ocean.

It appears that the sea is constantly washing away the southern coast of this island, for the people informed me that they set their fences three or four feet from the edges of the cliffs, and they are obliged to remove them back from the brow of the cliff that distance every three years, so it is evident that the land is gradually wearing away. The mode of operation is first by undermining the cliffs, and then the top tumbles down and is spread along by the surf, the fine particles being washed away into the sea, while the large stones remain to form a barrier on the shore, and protect it against further encroachments. If these stones are carried away, the defence is removed, and more rapid degradation will take place.

At the north extremity of the island there is a long beach of white sand, containing alternate beds of black crystals of magnetic iron ore. It is a good blotting sand, and may be obtained in great abundance, and can be rapidly picked out from the silicious matter by means of a magnet, which will take up all the particles of iron ore.

The sandy region extends from the light house at Sands Points to the clayey cliffs on the S. W. side of the island. At the north part of this island exists a large Salt Pond, and through the beach the sea has ingress by means of a breach, that was formerly used as a channel, by which the boats were passed into the pond, to rescue them from the surf. Owing to the constant action of the sea, it is impossible to keep this channel open, and hence it is but little used. Another artificial breach was made, but with no more successful results, and I do not think it worth while to attempt to make a dock of the salt pond, since it is too shallow for any but open boats, and a passage dug through the sand at considerable expense may be filled by the next stormy sea that washes the beach.

There are no trees upon Block Island, and since wood fuel is too expensive for general use, it most fortunately happens that nature has amply provided the inhabitants with a great and almost inexhaustible supply of peat, or tug, as it is called. Thus every family owns a peat bog, which is their depository of fuel, from which they draw an ample allowance yearly.

Attached to every dwelling we find a "tug house," in which is stored up the winters fuel, and each family burns from 25 to 35 cords of peat per annum.

The mode of preparing it is, in case it is a first cutting, to split out cakes of it about six inches square, which are laid upon the bank to dry in part, after which it is turned, and subsequently is piled up in open stacks, through which the air circulates and completes the process. In case an old bog is dug over, the peat is made by the hands into balls as large as a twelve pound cannon shot, and these are laid on the ground partially dried, and then stacked like piles of cannon balls. They become firm and burn very well, giving out a large and clear flame, and making a good coal. The people all have their fire places arranged with peat grates, or frames made of bar iron, large enough to fill a kitchen fire place. On this they lay the peat, and it proves to be an excellent fuel, giving a good clear fire, suitable for all kinds of cooking, and for the warming of apartments.

I think that most persons would give up their prejudices against peat, if they should spend a few weeks among the people of this island.

I was informed by several old persons, that they well remembered when several tug bogs were entirely dug out, and that by throwing back the loose turf, the peat grew again in 40 years, so as to fill the bogs. I was assured that such was the case with many of the swamps that I visited. Berzelius says that the same opinion prevails in Sweden, but that accurate observations have proved it to be an error.

I shall not be able to enumerate all the peat bogs of Block Island, and it would hardly be needful, since it may be stated in general terms that almost every little valley on the island contains a few acres of it, and its depth varies from four to ten feet. There is evidently enough left, even if it does not grow, to supply the inhabitants with fuel for ages.

Indian corn grows well on Block-Island, and the crops vary with the amount of manure used, from 20 to 60 bushels to the acre; the average crop being estimated at 25 bushels. The present year has been unfavorable to such crops, since the violent early autumnal gales injured the silk of the growing corn, and thereby caused much of it to suffer from blight. On this account the crop will prove very small.

Owing to its situation in the midst of the sea, the climate of this island is moderate, the extremes of heat and cold prevalent on the main land being unknown, for the wind passing over so large a sheet of water, is rendered more temperate. Hence, as would be expected, the summer seasons are found to be temperate, and winter is less severe. But owing to the former circumstance, the corn crops do not ripen so soon as they do on the main land, nor do they dry so quickly, on account of the humidity of the atmosphere.

I obtained from the farmers such statistical information as was practicable, the following having been communicated to me by Mr. William Pitt Sands, who is esteemed to be one of the best agriculturists upon the island.

In 1831, Mr. Sands tilled 13 acres of land, manured it with a compost of seven tons of seaweeds, mixed with soil. His crop amounted to 387 bushels of corn, equal to $29\frac{7}{10}$ bushels to the acre. The crop, for the present year, from causes which I have mentioned, will not amount to more than 100 bushels upon 17 acres of land.

Mr. Sands has used peat ashes as a top dressing, and says that it brings in a spontaneous growth of white clover. He has never used peat, or peat compost, for manure, and says that he observed that where the peat had been spread to dry, the soil only produced sorrel and other sour feed.

This is the usual effect of peat, when its acid properties are not neutralized by composting, after the manner that I have indicated. I am satisfied, nevertheless, that this peat may by easy processes be made into the most powerful of manures. I would therefore earnestly recommend its use, and would advise the people to save the refuse of their fisheries, which is now thrown away instead of being mixed with peat and lime, to form a valuable compost, as might be done to great advantage.

Mr. Sands has used gypsum as a top dressing, without any beneficial effect. He has also used a small quantity of lime in the same manner, with but little effect. He has used saltpetre in his cabbage garden with great success.

Rye is an uncertain crop. Barley is said to suffer from "scalding," the sun acting upon the rain or dew which covers the stalks of the grain. Grass crops are generally good, and the yield is about one ton to the acre. There has been a falling off in this crop since 1834, probably from neglect.

I took specimens of the soils of this farm, which have been analyzed under my direction, and are reported in the following tables, as are also the analyses of the soils from various farms on the island. It was difficult for me to obtain statistics of the crops for the present year, and they would be very far short of the fair average, which ought to be stated, since the season has been most unpropitious, and the crops of corn, which are the most valuable of the products, are generally small. For analyses of peat see annexed tables.

Having completed, so far as practicable, all the required examination into the geology and agriculture of New-Shoreham, we took passage in a New-London fishing-smack, and sailed to Newport.

REMARKS

ON THE

ORIGIN OF SOILS.

In order to understand the nature of soils, as affected by their mineral bases, we must first consider their geological origin.

It is an established fact, that all soils were originally produced from the disintegration and decomposition of rocks, effected by the chemical and mechanical agency of air and water, their elements reacting upon the decomposable minerals, while water, aided by the powers of cold, heat, and by its currents and waves, served still more effectually to crumble and transport the detritus. These matters being in the course of time commingled with various decomposed vegetable and animal substances, constitute soils. Growing plants are also found to aid the decomposition of solid rocks. Lichens and mosses serve to keep the surface of a rock moist, and thus favor the chemical action of the air and water on the oxidizable minerals. When vegetable matters decay, they also act as decomposing materials, since acids are formed capable of combining with potash, soda, lime, magnesia, oxide of iron, manganese, and other bases, so as to separate them in the form of salts, which are absorbed and decomposed by living plants.

Carbonic acid gas is also produced by the decay of vegetable and animal bodies, and is capable of eliminating the alkaline matters from the felspar of granite, so as to effect its decomposition.

Among the mineral substances that aid the decomposition of rocks, the bi-sulphuret of iron, or pyrites, is by far the most rapid and powerful. It abounds in almost all kinds of rocks, and any observing person may note frequent instances where its action is visible. Pyrites attracts oxygen from air and water, the sulphur being converted into sulphuric acid, while the iron becomes also an oxide, and the acid and oxide formed combine, producing sulphate of iron, or copperas. When the sulphate of iron comes in contact with felspar, it is decomposed, the sulphuric acid combining with the alkaline and other basic substances, to form sulphates, while the oxide of iron is deposited in the form of iron rust. A similar reaction is also observed when the pyrites exists in slate rocks; but since that rock contains alumina, magnesia, and lime, the sulphates of those bases are formed.

When a rock contains iron, or manganese, in a low state of oxidation, by exposure to air and moisture, those oxides attract more oxigen, and increase in bulk so as to cause the rock to cleave into thin layers, which are hove off by the mechanical agency of freezing water, or are worn off by friction and by the currents of brooks and rivers.

Freezing water exerts an immense power, and is one of the most effectual means employed by nature in crumbling the rocks into soils, while it also serves as a ploughshare, since by each freezing the ice expands, and drives the particles of soil farther from each other, so that its texture is found loose and open in the spring season, and ready for the germination and growth of plants.

In pointing out some of the most conspicuous causes that serve to decompose and crumble the rocks, I would take occasion to state, that there are abundant geological proofs of the existence of vastly more powerful agencies in former times, when our globe was subjected to the action of an overwhelming ocean, with its rapid currents and tumultuous waves, such submergencies having been of frequent occurrence, as is attested by the abundant alternations of marine and terrestrial relics included in the strata of the Transition, Secondary, and Tertiary formations, while the transported blocks of stones, boulders, and diluvial sand and gravel, with scratches on the surfaces of the rocks, coinciding with the direction of the current, all testify that a general deluge has passed over the surface of the globe throughout the northern hemisphere. After considering all these circumstances, and the immense antiquity of our globe, we cease to be astonished at the amount of soil that has been produced by such agencies, and are prepared for another fact pointed out in geology, viz. : that such phenomena have been often repeated on the face of the earth. Many successions of soils having taken place, dating their beginning from the deposition of the primary strata on which the first soils were deposited, and having produced their luxuriant crops of tropical verdure, have since been again consolidated into rocky strata, bearing abundant impressions and casts of those plants that grew upon them while the accumulations of the vegetable matters them selves, are consolidated into beds of coal.

The same phenomena were repeated several times in succession, from the slate rocks containing anthracite, up to the secondary new red sandstone formation of the bituminous coal measures.

Adolph Brogniart, in his "*Prodrome d'une Histoire des Vegetaux Fossiles*," indicates four ancient periods of vegetation anterior to the present state of things, when there must have been soils bearing their peculiar plants, all of which are now consolidated into rocks, but still preserve distinct prints recording in their herbarium a history of the flora of the ancient world.

Although some persons may marvel at the fact that all soils originated from the crumbling and decomposition of rocks, and may be disposed to consider the quantity of modern soils too great to be accounted for in this manner, their surprise will cease on comparing the relations of this detritus to the mass of the globe itself.

The mean diameter of the earth is 7911 miles, while the average depth of the soil on its surface, is not more than 15 or 20 feet, allowing it to be spread evenly over its rocky crust. This would be less, in comparison with the bulk of the globe, than the slightest tarnish of rust on the surface of a sphere of iron 100 feet in diameter, when compared with its mass.

In estimating the time required for the decay of rocks to this extent, we are not to estimate it by the present rate of disintegration, for as before suggested, the causes formerly in action, were vastly more energetic than they are now.

Thus far, no one has been able to translate geological into astronomical time, and it is utterly impossible for us to estimate even approximatively the antiquity of the earth. It is evident, however, that there has been time enough for all that has taken place, and it is of no great consequence for our present purpose, to represent any measure of years as the period required for the formation of soils. We see the operation daily going on around us; in some places slowly and imperceptibly, in others, rapidly and visibly; but every where the all-destroying tooth of time is at work upon the rocks, reducing them to powder, suitable for the sustenance of vegetation.

Soils formed from the Primary Rocks.

This class of soils is by far the most prevalent in the State, and obviously derive their origin from the decay of granite, gneiss, and mica slate rocks, which form the basis of the southern portions of Massachusetts, and the western part of Rhode-Island.

Soils derived from the primary rocks are readily distinguished by the undecayed minerals which they contain, either in the state of fine particles or in larger fragments. In all such soils, it is easy to discern brilliant spangles of mica, sharp angular or rounded grains of quartz, and white and earthy particles of felspar, more or less masked by a coating of oxide of iron, or of vegetable mould. By mixing such soils with water, agitating the mass, and pouring off the finer materials, it is easy to detect the integrant minerals, even in the finest kinds of soil.

To these mineral ingredients are superadded various organic matters, derived either from the decay of natural vegetation, or from manures that have been introduced during the process of cultivation.

GRANITE SOILS vary in their productiveness, with their situation, the relative fineness and coarseness of the particles, and their order of superposition. The natural growth of forest trees on such soils, indicates in some degree, their strength and fertility.

The composition of granite soils is very similar to that of the minerals from which they were derived. Felspar contains silex, alumina, potash, lime, and occasionally a little of the oxides of iron and manganese.

Mica contains the same elements in different proportions, besides which, it has variable quantities of magnesia and fluoric acid, and occasionally a little lithia.

Quartz is pure silex, or flint, as it is commonly called.

On comparing a granite soil with the composition of granite, we perceive that the alkaline matter has, in a great measure, disappeared, and there is a large quantity of the per-oxide of iron left in its place. The oxide of iron being generally derived from the decomposition of iron-pyrites, sulphate of iron being first produced, and subsequently decomposed by the alkaline base, it is probable that the potash is in such cases removed in a soluble state. The crenic and apocrenic acids, which result from the decomposition of vegetable matters in the soil, also combine with alkaline matters and with lime, forming a highly soluble compound with the alkalies and less soluble salts with lime.

The potash procured by the leeching of wood ashes, is thus derived from the mineral kingdom—felspar, containing no less than 12 per cent. of that substance.

The hard glazed covering, or epidermis of the stalks of Indian corn, and of the various cereal grains, and grasses, is silex, a mineral substance, which alone is insoluble in water, but when combined with potash, or perhaps even with crenic acid, becomes soluble, and may in this way be rendered suitable for entering into the sap vessels of plants. The skeletons of the vegetable fibre and the walls of the cells are composed of a siliceous basis. Lime is found to exist in almost every kind of vegetable, and is always a principal component of their ashes.

Granite soils are generally better adapted for the growth of Indian corn, than for that of the smaller grains.

When underlaid by a hard pan of clay, bog iron, or hard gravel, cemented together water tight, they are capable of retaining soluble manures, and may be rendered very fertile. If the substratum is an open gravel, the top soil is too easily drained of its moisture, and is subject to loss of soluble manures by infiltration or leeching.

Grau-wacke soils vary in composition according to the nature of the conglomerated rocks from which they are formed. The coarse variety, or pudding-stone, yields only a coarse pebbly or gravelly soil, which is porous and unfit for tillage. The finer kinds, or the grau-wacke slates, produce a good soil, which is sufficiently charged with argillaceous matter, to make it retentive of moisture and of manures. More frequently there are mixed varieties of coarse and fine detritus, and when the bottom consists entirely of pebbles, the top soil is liable to loss of manure from infiltration. The soils of this class are known as hungry or leeching soils, and are generally unfit for cultivation. Seekonk Plain is a proper illustration of this remark.

The fine grau-wacke soils are generally more or less mixed with the detritus of carbonaceous clay slate, belonging to the coal formation,—the mixture being of a more clayey texture.

The slate rock itself, when crumbled into soil, is perfectly black, and produces good crops of grain, herdsgrass, and clover. It is apt to be tenacious of moisture, so as to require drainage by back furrows or shallow ditches.

Among the best soils of the State, may be ranked the mixture of detritus from the fine grau-wacke and carbonaceous slate rocks. The island of Rhode-Island and part of Tiverton being of this class.

Hornblende rock soils are formed by the decomposition of a dark green or black rock composed chiefly of the minerals, hornblende and compact felspar, with variable proportions of prot-oxide of iron and oxide of manganese. Soils of this class are generally of a dark red brown color, and are of fine texture, possessing a slightly adhesive feel when pressed together in the hand, but are not clayey. They are very warm and retentive in their nature, and are among the best soils of the state, but are, unfortunately, quite scanty in their distribution, the only tracts of the kind being in the towns of Cumberland, Smithfield, and Johnston. It has been remarked that the best orchards in the State are situated upon this kind of soil.

Hornblende rock soils are remarkable for the large proportions of oxide of iron, manganese, and magnesia, which they contain. The latter substance being combined with silex and water, is in no wise injurious, but on the contrary, supplies the place of clay as a retainer of moisture. Manganese acts favorably as a stimulant to vegetation, and the general dark color and imperfect conducting power of the soil renders it warm.

Serpentine rocks form, by their decomposition, a similar kind of soil, of a dark red brown color, but in too limited patches to become of agricultural importance.

LIMESTONE SOILS. The pure carbonate of lime in its crystalline state, is not capable of forming a soil of proper texture, but is a porous mass, subject to leeching. The same remark may be applied to the granular magnesian limestones, or dolomite, of Smithfield. Mixed with a sufficiency of argillaceous matter to render it retentive, calcareous soils are of the most fertile kind.

In Smithfield, where there is a mixture of the detritus of hornblende rock and limestone, a very luxuriant soil results, on which spring up spontaneously, white and red clover, with other sweet grasses, such as are common on limed soils.

No prejudicial influence is exerted by the magnesia in dolomite, so long as it is combined with carbonic acid, the chief difficulty in using lime prepared from that kind of rock arising from the long continued caustic state of the magnesia, when it has been calcined, since it robs the vegetables of carbonic acid, and thus injures their growth. By neutralizing the magnesia in the compost heap, it is easy to prepare such lime for agriculture, and it is more extensively employed in this manner in England. There is no need, however, of using the magnesian lime, for there is an inexhaustible supply of the soft rock, which is a nearly pure carbonate of lime, and is proper for agriculture.

TERTIARY SOILS, or antediluvial alluvium, occur in Rhode-Island, and are quite peculiar in their appearance. They consist of alternate layers of sandy clay, brown and white sand, arranged as if from tranquil deposition ; a few ripple marks, or waves, being the only signs of any currents in the water from which the subsidence took place.

In the vicinity of Providence there are numerous instances where sectional cuts have been made through cliffs of sand and gravel, arranged in nearly parallel zones. Rarely do we find the clay sufficiently pure for pottery, or for the manufacture of good bricks. On Block-Island, however, a good tough plastic clay abounds, and forms precipices 60 or 80 feet high along the coast.

On Seekonk river, upon the shore, may be observed a bed of plastic blue clay, that crops out from beneath Seekonk Plain, where it is about 20 feet below the bed of pebbles that exists immediately beneath the top soil.

Generally the clayey bands in the tertiary cliffs near Providence, are too much mixed with fine sand to become plastic. There are beds of a very fine variety of this clay and sand, that are frequently mistaken for calcareous marl, but they are not charged with a sufficiency of lime to deserve such a name. No marl has yet been discovered in Rhode-Island, and from the general absence of shells in the tertiary deposits, it is not probable that it will be found in that formation.

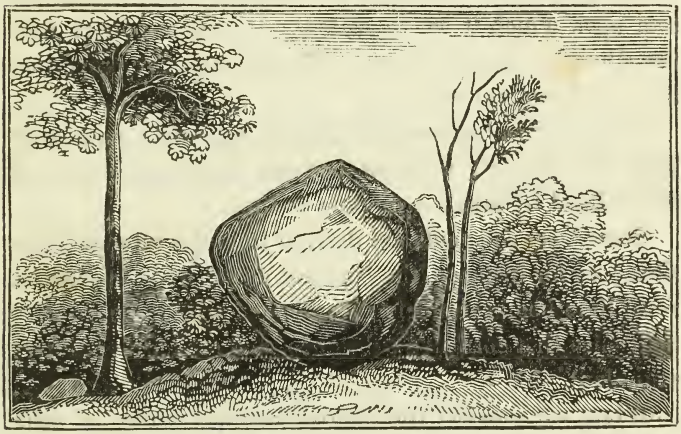
The tertiary soils of Rhode-Island are generally poor and light, and are wanting in vegetable matter and lime. They are of easy tillage, and may be much improved by means of a liberal supply of thoroughly limed peat compost, a kind of manure very easy to prepare, since peat and swamp muck abound in the vicinity. Fish may be obtained at a low price, and will serve to generate the ammoniacal salts, when composted with lime and peat.

The qualities of tertiary soils vary with the relative position of the sand and clay bands. If clay is near the surface, or constitutes it, then the soil is capable of higher improvement than the mere sandy beds, and by a suitable admixture of clay with the sand, a soil may be formed, sufficiently retentive, and capable of becoming fertile, under proper management.

By rendering light soils capable of producing good crops of grass, we are enabled to enrich them still more by turning in green crops, which draw their chief nourishment from the atmosphere, and a good vegetable mould may thus be prepared during the ordinary routine of cultivation.

Diluvial Soils. By the last great geological deluge, which took place after the elevation and consolidation of all the rocks, and subsequent to the deposition of the tertiary clays, much of the loose detritus on the surface of the earth was removed southwardly from its original localities. Not only were soils removed to great distances by this current, but even large blocks of stone and masses of iron ore were swept far to the south of their parent beds, and in their transit over the ledges they cut grooves and scratches which still remain to indicate the course of the waters, such marks being found very frequently where exposure to the weather has not effaced them. Thus when a ledge is uncovered of its top soil, the scratches may generally be found in great abundance.

Such appearances prove that the boulders were not freely floated on icebergs, but were driven over the surface of the rocks by the force of the current. Nor can we allow that any glaciers could have produced them by their loads of sliding rocks, for in that case they should radiate from the mountains instead of following a uniform course along hill sides and through valleys. It will also be observed, that such marks are common on table land where there are no mountains from which glaciers could extend. There are abundant proofs that a diluvial current swept the whole surface of the New-England States and all the northern portions of Europe, and it is probable that the phenomena proving such a cataclysm will be found in every portion of the northern hemisphere.



Diluvial Boulder of Granite resting on Gneiss, A. Arnold's estate, Smithfield.

By diluvial causes soils were also removed, commingled, and deposited far to the southward of their native locations, so that we rarely find any large deposits of soil excepting such as have undergone diluvial transportation. A few instances of soils truly indigenous to the rock on which they rest have already been noted, and it is probable since they are very thin that they are of post diluvian origin.

Recent alluvions consist of the fine particles washed down from more elevated land by the action of running water; rain, rivulets, and larger streams, being continually engaged in such operations. When a river overflows its banks, the channel being thus widened, its velocity is diminished, and alluvial matters are deposited on the low land overflowed. It was thus the Nile, in Egypt, annually deposited a layer of new and rich soil, and the great rivers of the western states frequently make similar deposits on their banks. Examples of the chemical composition of the alluvions of the Nile and of the Mississippi rivers will be given in another section of this Report. Alluvial soils are not always remarkably fertile, much depending upon the nature of the materials, and on the bottom upon which it is deposited. If this is porous, then the alluvium, unless clayey, will want retentive properties, and will soon run out.

It sometimes happens that alluvial vegetable matters are acid, and the soil will not become fertile until they are neutralized by alkaline matters or lime.

Sometimes the acids are derived from the mineral kingdom ; as for instance, the copperas clays, which are barren until lime has been freely incorporated with them, so as to neutralise that corrosive substance, and render it a salutary stimulant.

When we consider the electro-chemical nature of soils, manures, and amendments, we shall discover it to be essential that the electric powers should be in some measure balanced, in order to yield the best agricultural results. Chemical science arranges all bodies either as electro-positive, or electro-negative ; some as absolutely so towards all other substances, others only in relation to each other. The *electro-positive* are always the alkaline or *basic* substances, while the *acids* are always *electro-negative* when brought in contact with matters of the positive class.

If a soil is wholly positive or negative in its nature, it fails to be fertile, and when one power greatly predominates over the other, it is not in its most favorable condition. We must then endeavor to bring a soil to a neutral state, especially if it is decidedly acid. Silex is regarded as an acid, and alumina, lime, magnesia, iron, and the alkalies, are its opposites, or are electro-positive in relation to it. Vegetable acids, such as I shall describe, are also electro-negative, or acid reagents and must be combined with some basic substance in order to give the best results.

The movements effected by the different electrical properties of the component ingredients of soils, both of mineral and organic nature, must have a powerful influence on the growth of plants, since electricity is well known to be a most efficient promoter of endosmose or absorption, and the power although not visible or perceptible by the other senses where it acts in a gentle and diffused manner, yet slowly effects great changes, and is always the moving power in all chemical reactions where combinations take place.

Endosmose is a name given by Mons. Dutrochet to a peculiar power which he discovered in experimenting upon the permeability of tissues. Its name is from the Greek, and signifies internal impulse. It is one of the most curious and interesting properties that have been discovered within the last few years, and has been the subject of many elaborate experiments and essays. By stating the principles of one or two experiments, the reader will be enabled to understand this curious property, which is possessed by all thin membranous substances, when liquids of different densities and electromotive powers are placed on each side of the diaphragm.

If we take a tubulated cupping glass and tie over its mouth a thin piece of bladder, or other thin membrane, fastening it firmly to the rim of the glass by means of waxed thread, so as to render the apparatus tight, and then fix a perforated plate of metal so as to support the membrane, we have an instrument that will serve for an Endosmometer. Having bored a hole through a cork that will fit the tubulure or upper orifice, a glass tube, open at both extremities, is to be inserted. Fill the cupping glass with sugar and water, or any other undecomposed solution denser than water, and then plunge the cup into a vessel filled with water, so that it comes just up to the liquid inside of the Endosmometer at zero on the tube, it is evident that no pressure is exerted on either side. Now place a scale of paper or make marks with black paint on the tube, indicating inches and half inches, so as to be able to note what will follow. Very soon it will be seen that the liquid rises in the tube, and it will continue to do so until it flows out at the open orifice, provided the membrane does not yield or decay. Generally I have found the ascent to be equal to from one half to two inches per hour, the rate of progression diminishing with the height, but not regularly, for there are some peculiar states of dilution in which the action is most rapid, and the rise will be found to vary accordingly.

Dutrochet determined the ascensional force, in such an instrument, to be equal to the pressure of a column of 28 French inches of mercury, or about the weight of the atmosphere. It should here be noted, that the pressure of the air is equally exerted on both sides of the instrument, and has nothing to do with the phenomenon.

Mirbel, by experiment, found the ascensional power of the sap in a grape vine to be the same as was discovered by Dutrochet, in his new instrument. That is, the ascent of mercury in a tube, produced by the outpouring of the sap from the top of a grape vine, which was cut off while the sap was flowing and sealed up over the mercury, raised the mercurial column 28 inches in the tube.

If electricity be employed in the experiment with the endosmometer, we immerse the negative wire in the endosmometer, and the positive wire is placed in the water outside, then the water will pass into the instrument and the fluid will rise in the tube. This instrument is here mentioned as a mechanical illustration of the absorbent system of plants, which have an infinity of such endosmometers in their structure, for every rootlet has its spongioles, which are little bladders that stand out from the imbibing portions of the roots, and every cell has its diaphragm of membrane, in which the endosometric action is produced. We should also remark that the fluids constituting the common juice, or ascending sap of plants, are denser than water ; and hence, are a proper excitant of endosmose. There is another peculiarity about the instrument, which is, if any putrid substance is placed within it, or if sulphuretted hydrogen be mingled with the syrup, it becomes instantly paralyzed ; and the moment the membrance begins to putrify, the fluid that had ascended in the tube passes down and filters out ; and this is not owing to any opening being formed, for the membrane is found to be perfect when examined.

I shall also remark that an opposite movement of much less magnitude takes place in this experiment, and it will be found that the fluid passes out in smaller quantities than the water enters. This external impulse is called exosmose.

I have repeated nearly all the experiments described by Mr. Dutrochet, and can vouch for the correctness of his results so far as here stated.

The chemical nature of soils and manures will open a vast field for philosophical inquiry, and every new suggestion should receive its due weight. How far the opinion of Decandole, respecting excretion from the rootlets of plants, will find support, on minute examination, is not yet decided, but the facts related by him, and the experiments of Dutrochet on exosmose, appear to give a greater degree of probability to the theory than was before attributed to it by botanists and chemists.

The study of the physiology of plants has been too exclusively yielded to botanists who were not experimental chemists, and hence arises much of the uncertainty of their results.

Liquid manures act chiefly upon the roots of plants, and gaseous matters are absorbed and decomposed by the leaves.

Stimuli applied to the roots affect the foliage, and on the other hand, the stimulus of light and heat upon the leaves, promotes an accelerated absorption by the roots, so that they reciprocate each other's actions. The phases in the life of a plant are very peculiar. In its different stages of growth, opposite actions take place at particular periods. Thus, during germination of the seed, carbonic acid is extricated. When the foliage puts forth, that gas is absorbed and continues to be taken up until the seed or fruit begins to ripen, then the plant gives out carbonic acid gas. At the period of the formation of the fruit, the plant draws upon the manures in the soil.

Since the foliage derives its chief nourishment from the atmosphere and from water, and when the seed is not allowed to ripen, plants do not draw upon the manures in the soil, and thereby exhaust its fertility, we perceive the importance of a proper rotation of green crops with those cultivated for their seed or fruit.

Grass or other green crops being raised and turned in, add to the soil matter which they have absorbed from the air, and the field is enriched.

Saline manures act by stimulating plants, to increase their foliage, and they ought to be used on the young crop for that purpose, and should not be put on the soil at the epoch of germination, nor at that of the ripening of the seed, since they act against both germination and ripening, when plants are giving out carbonic acid gas.

AGRICULTURAL STATISTICS,

COLLECTED DURING THE SURVEY.

Glocester. Near the village of Chepachet, the soil is of a light yellow color and originated from the decomposition of granite, gneiss, and mica slate rocks, boulders of which are abundantly scattered over its surface. The top soil is generally light and loose in texture, but it is underlaid by beds of clay which are from 5 to 20 feet below the surface. There are also hills of diluvial sand and clay in regular layers, sloping in curved lines to the north-eastward.

The soils generally, in this town, when not too rocky, are of easy tillage, and if sufficiently manured, produce good crops. Corn does well, wheat has been raised, and the crops were about 20 bushels to the acre. Mr. S. Y. Atwell, a resident in this town, owns and cultivates a small farm. He informs me that he finds carrots to be one of the most profitable of his crops. Millet is also found to be a good crop preparatory to laying the ground down to grass. Potatoes and grass crops are usually considered among the most profitable agricultural products.

Analysis of the Soils of Glocester.

1000 grains of soil from the farm of W. Tourtellot, of Glocester. The soil is diluvial granitic detritus, color dark brown.

Mechanical Separation.

No. 1.	Granite pebbles,	26
2.	" sand,	83
3.	Fine loam,	891
		1000

Chemical Analysis.

Water,	=	5.0
Vegetable matter,		12.4
Insoluble silicates,		76.0
Per-oxide iron and alumina,		6.2
		99.6
		4 loss.

At the south-west corner of Smithfield, is the village of Greenville, where the soil is decidedly good, and although we have not yet received any statistics from the farmers, I am able to state, from an examination of the country, that agriculture is there carried on in a neat, and, doubtless, profitable way. The intervales, at the time of my exploration of that portion of the country, were covered with rich verdure, and promised abundant crops of hay. The soil of the uplands is of a yellow color, and owes its origin to the decay of granite rocks. The intervales are charged with considerable quantities of black peaty matter, and appear to give the most ample returns to the husbandman.

Returning through Smithfield, I had occasion to make some observations on the soils situated southwardly from the Harris lime rocks. The native forest trees are oak, chestnut, black and white birch, and pines ; the chestnut mostly prevailing. Where this soil is cultivated, gypsum is said to act favorably, from which it is probable that the soil is somewhat charged with lime, as gypsum is known to prove beneficial on calcareous soils.

Ashes are also used advantageously, and that which has been leached is most frequently used, and is sprinkled upon the hills around the young corn.

Peat has not here been tried as a manure, and in very few instances in the state have I heard of its proper application, by composting. It abounds in the vicinity, and ought to be employed as an enriching material in the improvement of the soil. Irrigation is extensively practised in Smithfield, and produces good effects, especially on the hill sides, having a southern exposure. I visited the farm of Mr. Elisha Olney, a very sensible and good practical farmer, who furnished me with some statistical matter relating to the agriculture in his vicinity.

I visited the farm of Mathias Ballou, and after obtaining such agricultural information as he was able to furnish, I took specimens of his soils for chemical analysis.

Last fall he broke up about four acres of pasture, and spread barn yard manure upon it. In the spring he cross ploughed it, and spread a compost made of hog yard manure and swamp mud, and planted it with Indian corn.

He states that when he puts six cords of compost manure on the acre of land, his average crops of corn amount to 30 bushels.

The top soil is of a blackish color, and is about eight inches deep, and rests upon a subsoil of a yellow color, derived from granitic rocks.

Analysis of this soil.—Mechanical separation by sieves.

No. 1.	Pebbles,	= 135
2.	Sand,	136
3.	Fine Loam,	729
		1000

Chemical analysis of 100 *grains of the fine powder.*

Water of absorption,	= 4.9
Vegetable matter,	12.1
Insoluble silicious matter,	76.0
Per-oxide of iron,	4.0
Alumina,	2.6
Phos. and crenate of lime.	0.4
	100.0

This soil is very rich in vegetable matter, and is deficient only in lime and alumina.

The following analysis was made of the yellow subsoil taken from a forest of oak and chestnut trees in Smithfield.

Mechanical separation.

No. 1.	Pebbles,	67
2.	Sand,	190
3.	Fine Loam,	743
		1000

A chemical analysis of 100 grains of subsoil from the forest, gave the following results :

Water of absorption,	= 3.7
Vegetable matter,	5.6
Insoluble silicates,	80.0
Per oxide of iron,	6.5
Alumina,	3.2
Phos. and crenate of lime,	0.4
	99.4
	6 loss.
	100.0

In this soil we still find a deficiency of calcareous matter.

Analysis of soil from the farm of Mr. T. Smith, Smithfield. Soil light brown colored. Crop of oats.

Mechanical separation on 1000 *grains.*

No. 1.	Granite pebbles,	56
2.	Sand,	129
3.	Loam,	815
		1000

Chemical analysis on 100 *grains of the fine soil.*

Water of absorption,	= 1.7
Vegetable matter,	6.8
Insoluble silicates,	83.7
Per-oxide iron,	4.2
Alumina,	1.3
Phos. and crenate of lime,	0.7
	98.4
	1.6 loss.
	100.0

The above analyses will suffice, as fair examples of the soils in this region.

Jonathan and Nathaniel Hawkins cultivate the Aza Arnold farm, and their methods of cultivation are similar to those employed by the farmers of that vicinity generally; their crops are good, and the treatment of the land appeared to me to be enriching.

Analysis of the sub-soil from the corn field.

Mechanical separation.

No. 1.	Pebbles of quartz and felspar,	= 26
2.	Sand of the same,	46
3.	Fine loam,	928
		1000

Chemical analysis on 100 *grains of fine soil.*

Water of absorption,	= 2.3
Vegetable matter,	6.0
Insoluble silicates,	83.8

Per-oxide of iron and alumina,	5.5
Salts of lime,	0.2
Magnesia,	0.9
	98.7
	1.3 loss.
	100.0

In JOHNSTON there are some excellent farms situated on hornblende rock, and a dark blackish soil, mixed with peaty matter. The meadows contain layers of peat, and the soil generally is well charged with vegetable matter.

A good example of a fertile soil of this class may be seen on the excellent farm of Mr. D. Pettis.

Soil from hornblende rock mixed with granitic detritus. Crop, clover, very luxuriant.

Mechanical separation by sieves.

No. 1.	Fragments of hornblende rock and seinite with a few pieces of sticks,	=30 grs.
2.	Sand,	33
3.	Fine loam,	937
		1000

Chemical analysis of 100 *grains of the fine soil.*

Water of absorption,	= 3.3
Vegetable matter,	9.5
Per-oxide of iron and alumina,	7.9
Salts of lime,	0.7
Insoluble silicates,	78.6
	100.0

This soil evidently resembles a granitic more than a hornblende rock soil, there being no magnesia in it. It contains a larger proportion of lime than is usual in the Rhode-Island soil, and is rich in vegetable matter.

SCITUATE. The soils of this town are formed of the detritus of the primary rocks, and where well cultivated, they yield ample returns.

Mr. Benjamin Franklin Hopkins was mentioned as one of the most enterprising and successful farmers, and I proceeded immediately to his estate, and examined with him the soils which he cultivates. He informed me that his barley field was manured with 33 loads or 10 cords of fine compost, to the acre, last year, and that he put on in the spring of the present year, six loads more, and planted two bushels of barley to the acre. This field last season produced thirty bushels of corn per acre, and he expects to obtain the present year, 100 bushels of barley from the lot of three acres which is planted with that grain.

Analysis of soil from the farm of Benjamin Franklin Hopkins, in Scituate. Crop barley last year, now planted with corn. Soil is brown yellow.

Mechanical separation.

No 1.	Pebbles of gneiss rock,	100
2.	Sand of the same,	114
3.	Fine loam,	786
		1000

Chemical analysis on 100 *grains.*

Water of absorption,	=	2.0
Vegetable and animal matter,		6.7
Insoluble silicates,		86.1
Alumina,		2.5
Per-oxide iron,		1.9
Salts of lime,		0.8
		100.0

Mr. Hopkins has three acres of land planted with corn; and he informed me that he has manured this field with 116 loads of compost, which not being sufficient, he proposes to use fish manure on the remainder of the field.

(See statistical returns from this farm.—Mr. Hopkin's report, No. 1.)

Foster, like Scituate, has a soil derived from the decay of primary rocks, and it is not so highly cultivated as it might be were manures to be had in greater abundance. I obtained but little statistical information in this town respecting the methods and results of culture.

Thomas Bennet has a farm of 110 acres, much of which is covered with forest trees, and valuable wood lots will prove very important in this vicinity should the bog iron which occurs there ever be wrought. At present, Foster furnishes a large supply of wood for fuel, and it sells readily at the neighboring factories. The wood standing in the forest is worth $1 per cord, and when cut and delivered on the road side, it sells for $2 per cord. Mr. Bennet says that his wood lots furnish 20 cords of wood per acre, and one half of the farm is woodland.

The trees are chestnut, birch, maple, elm and hornbeam. The latter are usually large, and are valued highly for the toughness of the wood.

The produce of the farm is stated to be 25 bushels of corn to the acre, the manure of two cows only being used to enrich the soil. One and a half tons of hay is stated by him as his crop from the acre of land. And the hay sells for $12,50 per ton. The soil is said also to produce wheat, but he has only tried the small quantity of six quarts of seed, which gave him three and a half bushels of grain as the crop. It is probable that many of the newly broken soils will be found to produce this grain more luxuriantly than those which have been long cultivated, where lime has never been used.

Coventry, like the towns just described, has a granite soil, and it is too frequently rocky from the presence of deluvial boulders of granite and gneiss. Where the land is freed from rocks, it is tolerably productive ; but I have received no statistical returns from the farmers, and my visit being merely for an outline view, was not continued sufficiently long for me to form decidedly correct opinions respecting the modes of cultivation pursued by the agriculturists. The country abounds with valuable forest trees, which are cut for fuel, and sold in the neighborhood.

WEST-GREENWICH. From Coventry I went to West-Greenwich, and examined the rock formations, and measured the elevation of the land. Subsequently I revisited this town, and examined the soils, and peat bogs, with a special view to the improvement of agriculture.

A large portion of West-Greenwich is rocky, and much labor is required for the clearing of the stones from the soil so as to fit it for tillage. There are, however, clear tracts of excellent soil which will compare advantageously with other portions of the State.

When sufficient quantities of manure are employed in farming, the crops in this town have been generally good, and there are evidently abundant sources of manure in the unreclaimed peat bogs and swamp holes, in various parts of the town.

At Weaver's Hill, I examined a large swamp which contains a rich muck, varying from six inches to one foot in depth, and covering a great area of moist, swampy land.

On Nooseneck Hill there is a deep deposit of excellent peat, on the farm of George Dawley. The bog consists of three acres, and the peat is three feet or more deep.

Near the Nooseneck factories, there is a bog of peat, comprising an area of ten acres, and the peat is one foot deep. Another lot of four acres, called the Cranberry bog, has about one and a half feet depth of peat.

West from this, at the junction of Roan & Frye's streams, there is a bog of fifteen acres, said to contain an abundance of swamp muck.

These substances composted, will make a valuable manure, and may be easily used in the improvement of the soils.

On the north-eastern side of Escoheague Hill, there is a peat swamp of eight or ten acres area, which varies from six to twelve feet in depth. I examined this peat and found it to be very rich in vegetable matter, and capable of forming an excellent compost.

Large deposits of this valuable substance occur also on the estate of Mr. Thomas T. Hazard. The area of swamp muck and peat, owned by him, is not less than 46 acres, and it is from six to ten feet in depth. So important a source of vegetable matter will not be overooked by an intelligent farmer. Mr. Hazard will doubtless soon prove its importance by converting large quantities of it into compost manure.

Mr. Hazard informed me that he was in the habit of using 30 wagon loads of stable manure per acre, on his tilled land, and that his average crops were from 20 to 25 bushels of corn, 15 to 25 bushels of rye, 20 to 25 bushels of oats, 400 bushels of potatoes, per acre, and that he cut from one to two tons of hay to the acre on his mowing lands. He has not cultivated wheat to any extent, but observed that in one instance, he had tried it on a small scale, and from half a bushel of seed, raised eight bushels of grain.

From the ascertained fact, that his estate contains vast quantities of peat and swamp muck, which may, by easy methods, be converted into rich composts, it is evident that great improvements may be made by employing it for that purpose, and I consequently advised him to dig out large quantities of this natural vegetable manure, which, by placing it on the uplands to drain, might be lightened, and afterwards could be more easily transported to his barn-yard and hog-styes, where it should be made into compost with any animal manures and lime.

On the Escoheague Hill I also examined the farm of Mr. Jason P. Stone, and selected specimens of his soils for chemical analysis, as they may be considered to be fair samples of the soils upon the hill and vicinity.

Soil from grass land, top dressed with gypsum.

No. 1.	Pebbles,	80
2.	Sand,	146
3.	Fine loam,	774
		1000

Chemical analysis on 100 *grains of the fine soil.*

Water of absorption,	=	4.8
Vegetable matter,		11.9
Insoluble silicates,		76.0
Per-oxide of iron and alumina,		5.8
Sulph. and phos. lime,		0.5
		99.0
		1.0 loss.
		100.0

This soil is sufficiently charged with vegetable matter, and may be improved by a liberal dressing with lime or ashes.

Mr. Stone is of opinion that gypsum acts favorably on his soils, especially in the cultivation of potatoes. In order to satisfy myself of the fact, I requested him to dig some of the hills in a field where the experiment had been tried and the potatoes were ripe. On examination we found several rows of hills across the field had been treated with gypsum, and the others had not received any. The potatoes were dug out from several hills, and the following proportion was found. Where no gypsum had been used, the number of potatoes in the hill was from seven to ten, averaging eight and a half—where gypsum had been used, from twelve to fourteen, averaging thirteen ; and the latter were of larger size. The average crop is estimated at 200 bushels: so the result was in favor of the gypsum. He has used this amendment also on his grass lands, spreading broadcast two bushels of the ground plaster per acre. His crops of hay were on an average one and a half tons to the acre.

He observed that 15 years since his soil was first broken up, and would not then produce more than 10 bushels of corn to the acre, but by cultivation he has rendered it capable of yielding 55 bushels. The quantity of manure used on this land yearly is 20 wagon loads to the acre.

On digging into the various parts of the farm, I found the top soil to be a greyish or black loam, with a subsoil of a yellow color resting on a hard pan three feet below.

Richmond. At Mumford's mills I examined a peat bog near the banks of the stream opposite the tavern kept by Mr. Hazard. The bog contains from 10 to 12 acres area, and the peat is from six to eight feet deep.

Exeter is based upon granite and gneiss rocks, and the soils were formed of the detritus of those rocks, and are like other examples which I have had occasion to mention. On the branches of Wood River there occur several deposits of swamp muck and peat, which may be used for enriching the soil.

Richmond and Hopkinton. The soil of these towns is of a similar character, as is also that in a large portion of Charlestown and Westerly.

Chemcial analysis of a greyish white sand from Hopkinton, a substance mistaken for calcareous marl. Mechanical separation of 1000 *grains.*

No. 1. Pebbles,	128
2. Sand,	172
3. Finest sand,	700
	1000

Chemical analysis of 100 *grains of the fine sand.*

Water of absorption,	0.8
Vegetable matter,	0.9
Insoluble silex,	95.1
Manganese and oxide of iron,	2.6
Lime and magnesia, a trace,	
	99.4
	.6 loss.
	100.0

This substance is very frequently mistaken for calcareous marl, which it resembles in its external character, but it is at once known to be siliceous by the action of chemical tests.

WESTERLY. Pawcatuck village, in the town of Westerly, is based upon granite rocks, and the soils are similar to those already described, but on account of the neighborhood of the sea, different manures can be easily obtained. Owing to rainy weather my examination of this town was necessarily imperfect, but I gained some statistical information from the Hon. Mr. Dixon, who cultivates several tracts of land near the village. He informed me that his average crops of corn were from 20 to 30 bushels to the acre, and that he uses fish for manure.

The price of fish employed for this purpose varies from 10 shillings to $2 per thousand, and the average weight of the fish is half a pound each. Generally two fish are put into each hill of corn, and they prove to be a transient but powerful manure.

Peat exists abundantly near Borden's Pond, forming a bog not less than two miles long, and extending southwardly from the pond. It has not yet been used in agriculture, and I doubt not when its value as a basis for fish composts is understood, that it will be eagerly sought for, and extensively used.

I beg leave to direct the reader's attention to the experiments made by Mr. Joseph Sanford, of Wickford, who has used the kind of compost to which I refer with remarkable success.

I would observe before leaving this place, that Pawcatuck village is situated upon the borders of a river of the same name, which is navigable for the distance of six miles from its mouth, and that the town on its margin is a pretty village, where the people appear to be enterprising and many are engaged in building vessels.

Seekonk. On my way to Bristol, I visited the farm of Dr. Johnson Gardner, of Seekonk, which appeared to be very neatly and judiciously cultivated. His tillage amounts the present year to twelve acres planted with corn, and manured from the stable and hog yard. Ten acres sowed with oats, three bushels to the acre, and no manure applied this year, and two acres planted with potatoes. He uses stable and hog-yard manure, and has also spread ashes over his fields with good effect. His grass lands yield about one ton of hay to the acre, on the average. Corn, barley, oats, and grass, are the most profitable crops which he raises.

The soil originated chiefly from the detritus of grauwacke rocks, and is light, and of easy tillage. It is similar to many soils in Rhode-Island, and I therefore took two specimens of it for chemical analysis, expecting to obtain, at the close of the season, some statistical returns of the results of his labors, but have not received the farm reports left with him to be filled. (See analysis of the soils of this farm in the tables.)

Barrington. This town is founded upon the fine grauwacke rocks, and the soils are derived from similar materials mixed with sienite, and are generally fertile, especially when sufficiently manured. Several bogs, filled with excellent peat, occur in this town, near the country seat of Dr. Joseph Mauran, of Providence ; and that gentleman has zealously commenced the preparation of composts, in accordance with the rules I have given. He will, doubtless, be able to satisfy every intelligent farmer as to the importance of peat in the manufacture of compost manures.

I examined the bogs, and found that the peat was of the best kind, capable of being used for fuel, compost, or if drained, turned over with the plough, and rolled down, the bogs may be advantageously cultivated, and will be found to be vastly more productive than any of the uplands.

The proper dressing for surface of the cultivated peat, will be a compost manure made of two thirds in bulk of peat and one third of stable manure, and a cask or two of lime to the cord, with which it will be advantageous to mix a quantity of earth, since the peat land is improved by a suitable admixture of such matters.

The bog owned by Dr. Mauran and Mr. Bicknell, comprises six acres, on which the peat is from five to twelve feet in depth, and may be very easily drained in a thorough manner by ditches, which may be cut around its borders, and connected with covered cross drains. It is easy to excavate the ditches, and the peat thrown out from them may be allowed to drain, after which it may be carried to the hog or barn yards, and there be composted. The ditches may be filled with loose rocks, and then covered, so that no obstruction may exist to a free passage with wagons and ploughs, during the process of cultivation. (See the appended letter of Elias Phinney, Esq., of Lexington, Mass.)

Analysis of soils from Dr. Mauran's farm, in Barrington. Brown yellow soil.

No. 1. From the field planted with corn last year.

Mechanical separation.

No. 1.	Pebbles of sienite,	17
2.	Sand,	150
3.	Fine loam,	833
		1000

Chemical analysis of 100 *grains of the fine loam.*

Water of absorption,	= 1.6
Vegetable matter,	6.4
Insoluble silicates,	85.1
Salts of lime,	0.7
Per-oxide of iron and alumina,	5.9
	99.7

No. 2. Soil from the garden, said to be the best on the farm. It is a light yellowish brown sandy loam.

Mechanical separation on 1000 *grains.*

No. 1.	Pebbles of sienite,	= 63
2.	Fine sand,	15
3.	Fine loam,	922
		1000

Chemical analysis on 100 *grains of the fine loam.*

Water,	1.9
Vegetable matter,	5.6
Insoluble silicates,	85.3
Alumina and per-oxide iron,	4.9
Salts of lime,	1.9
	99.6

Soil from Dr. Mauran's farm. Crop, last year, potatoes, no manure. Said to be the poorest soil.

Mechanical separation of 1000 *grains.*

No. 1.	Pebbles of granite,	= 68
2.	Sand,	200
3.	Fine sandy loam,	732
		1000

Chemical analysis on 100 *grains of the fine loam.*

Water,	= 1.4
Vegetable matter,	3.7
Insoluble silicates,	89.8
Oxide of iron and alumina,	3.7
Salts of lime,	0.4
	99.0

It will be seen by the above analysis how great improvements may be made in the composition of these soils, by the addition of more vegetable matter and lime in the state of a fermented compost.

I visited the farm of Mr. Nathaniel Smith, near Rumstick Point, and obtained the following statistical information. Eight hundred bushels of onions, and 150 bushels of beets, were raised together on the same acre of land. The carrot crops amount to 1000 bushels to the acre. Corn, 40 bushels to the acre. He cuts 2 1-2 tons of hay per acre on his mowing land.

The manure used upon this farm is mostly sea weed compost from the hog yard, and barn manure. He spreads 15 loads of the compost per acre.

Marsh mud has been used as an ingredient of compost on this soil with very good effect.

The whole area of the farm is about 200 acres. The stock of cattle consists of 60 or 70 cows and oxen. A large number of good looking Byfield swine are kept, and are littered with eel grass, which is converted into compost.

Warren is an active business place, and although not a large town, sends a great number of ships upon whaling voyages, there being no less than 20 sail employed in this business.

The following memorandum was handed me by one of the mercantile gentlemen of the place.

Shipping of Warren, R. I., September, 1839.

17 Ships.
2 Barques.
12 Brigs.
2 Schooners. } Aggregate, 8756 tons.
9 Sloops.
—
Total, 42 sail.

6179 tons of the above shipping is engaged in the whale fishery.

Although navigation employs many of the enterprising people, still there are well cultivated farms, yielding abundant crops; those on Warren neck being considered the best, I visited them and obtained specimens of the soils, and collected such agricultural facts as were obtainable.

Mr. Mason's estate, on Warren neck, comprises 270 acres, and is a good farm. He has 35 acres of tillage. The soil is a retentive clayey loam, derived from grauwacke slate, and shale, and is underlaid by a clay pan.

His corn crop this year was injured by the autumnal gales, and amounted to but 30 bushels to the acre; but in good seasons he sometimes raises 70 bushels.

The grain crops on this farm were as follows:

Barley,	30	bushels to the acre.
Rye,	20	" " " "
Oats,	27	" " " "

The potato crop amounted to 300 bushels.

I visited, also, the farm of Mr. Anthony Chase. He informed me that he raised from 10 to 30 bushels of corn per acre.

He has used fish for manure, and says that they are most advantageously spread on swampy land, with a clay bottom.

On his poorest land he spread half a bushel of lime, but could not perceive any benefit resulting from it.

The most profitable of his crops is grass, and the yield is from one to two tons of hay to the acre, according to the soil.

He has used marsh and swamp mud with some success.

The soil on this farm is a good textured, yellow, clayey loam, rather poor in vegetable matter. It has a hard pan of clay and sand, two feet below the surface, and by skilful management may be brought into a very luxuriant condition.

I visited the farm of Mr. Barton, who has begun to make use of his peat and swamp muck for composting, and has obtained favorable results. He owns 20 acres of bog, where the fine peat is about four feet deep. The bog is not easily drained, but a sufficiency of the swamp muck can be obtained at the proper season. Mr. Barton has used both recent and spent ashes on his farm, with good effect.

The farm of Mr. Peter Church, on Bristol neck, near Warren, is pretty well cultivated. His onion crop this year was 600 bushels to the acre. The potato crop was from 175 to 200 bushels to the acre. The grain crops were 30 bushels of barley, 25 bushels of rye, and 30 bushels of oats, per acre.

He raises carrots among the onions advantageously.

The manure employed on the farm is mostly made from sea weeds composted in the hog yard with earth. This compost is spread at the rate of 20 loads to the acre, on ploughed land.

Pasture is used for sheep for 10 years, then it is ploughed and planted with corn. It is the next year sown with oats or barley, and on the third year it is laid down to grass again. It is then used for sheep pasture again, and the rotation of crops as above mentioned is again effected.

Bristol is a handsome town, and is distinguished for its navigation business, a great number of whale ships having for many years been sent to the Pacific Ocean. During the past few years this business has been gradually diminishing, and now there are but five ships and two brigs employed in the whale fishery; twelve of their vessels having within a year been sold to the people of Warren.

There are many excellent tracts of land within the limits of this town, and agriculture advantageously employs a large proportion of the people. Few districts can be compared with the soil of Bristol in their crops of onions, which are raised in immense quantities for exportation. Carrots are also raised in abundance, and are uncommonly large and well formed. These are probably among the most productive of their crops, and bring a considerable revenue to the place. Ruta baga and mangel wurtzel, are also successfully cultivated.

I collected and have analyzed many specimens of soils and of peat from this town, but have not received any statistical returns respecting the crops cultivated upon them, excepting a brief note accompanying specimens from the farm of Messrs. Monro & Gifford.*

Chemical analysis of soils referred to in the annexed note.

No. 1. This soil is of a light grey color.

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* Doct. Jackson,

Dear Sir—The parcels of earth contained in the three shot bags, were taken from a ten acre field. No. 1, from a portion that appears never to have been broken up. No. 2, is from a portion that has been tilled for several years, although not yet rendered very fertile. No 3, is from another portion of the same field, which from some cause or other appears different from the other portions, being light or loamy.

Yours respectfully,

MONRO & GIFFORD.

Bristol, June 7, 1839.

Mechanical separation on 1000 *grains.*

No. 1.	Pebbles and sticks,	= 31
2.	Sand,	51
3.	Loam,	918
		1000

Results of chemical analysis of soil No. 1. 100 *grains of the fine loam, analyzed, give*

Water of absorption,	= 1.6
Vegetable matter,	5.4
Per-oxide of iron and alumina,	8.5
Salts of lime,	0.3
Insoluble silicates,	84.2
	100.0

This soil, if cultivated, will require both vegetable manure and lime.

Soil referred to in note as No. 2. It is of a dark grey color, and contains pebbles and shingle of slate.

Mechanical separation on 1000 *grains.*

No. 1.	Slate shingle, and pebbles of the same,	= 43
2.	Smaller particles, and sand,	95
3.	Fine loam,	862
		1000

Chemical analysis of 100 *grains of the fine loam.*

Water of absorption,	= 2.0
Vegetable matter,	7.2
Insoluble silicates,	82.0
Per-oxide of iron and alumina,	7.6
Salts of lime,	0.5
Magnesia,	0.2
	99.5
	5 loss.
	100.0

This soil having been produced by the disintegration and decomposition of grau-wacke and clay slate, derived its magnesia and alumina from those rocks. It is a retentive soil, but cold, and may be improved by the addition of limed composts, or animal manures.

Tiverton. I visited the farm of Judge Durfee, and obtained specimens of soil for chemical analysis, and was also politely furnished with statistical information by that gentleman, who has since been pleased to fill up and return to me a farm report, herewith appended. I took a specimen of soil from his oat field, and one from that sown with wheat, the chemical analyses of which are subjoined. The oat field comprises seven or eight acres, and was at the time of my visit, covered with a heavy crop ; no manure having been used this year.

Last year he raised Indian corn upon this lot, and obtained from 45 to 50 bushels to the acre. A patch of mangel wurtzel was also raised, and appeared luxuriant.

The wheat field, comprising three quarters of an acre, was manured last year with barn-yard and fish manure ; but none was put on the field the present year. The seed wheat was steeped in brine and rolled in lime, as is customary, and was planted early. It is of the Chinese variety, but little barbed at the extremity of the ear. On examining the crop, I found some of it smutty ; but generally it appeared to be in good condition.

Judge Durfee has made a compost of 115 barrels of fish and 40 or 50 loads of swamp muck, which he will use as a manure next year. (See his farm report, No. 2.)

Analysis of soils from Judge Durfee's farm.

Mechanical separation.

No. 1.	Layers of slate,	= 250
2.	Sand and fragments of slate,	139
3.	Fine loam,	611
		1000

Chemical analysis on 100 *grains.*

Water of absorption,	= 2.5
Vegetable matter,	7.9
Insoluble silicious matter,	79.7
Per-oxide iron and alumina,	8.1
Phosphate of lime,	0.7
	98.9

Oat field.—Chemical Analysis on 100 *grains.*

Water,	= 3.90
Vegetable matter,	8.75
Silicious matter,	76.50
Alumina and per-oxide of iron,	7.60
Phosphate of lime,	0.30
Magnesia,	0.45
Oxide of cobalt, not weighed,	
	97.50

Analysis of the soil from the wheat field.

Mechanical Separation.

No. 1.	Slate,	204
2.	Finer particles,	116
3.	Loam,	680
		1000

Chemical Analysis.

Water of absorption,	= 4.2
Vegetable matter,	8.2
Silicious insoluble matter,	78.6
Alumina and oxide of iron,	7.3
Phosphate of lime,	.25
Oxide of cobalt, traces,	
	98.55

The presence of oxide of cobalt in this soil is very remarkable, and there must be some vein containing that metal, in the clay slate rocks from which this diluvium was formed. The soil is strongly retentive, and is capable of high cultivation by means of limed composts, calcareous matter being the only ingredient that is deficient in quantity.

Where fish manure is used, as I have before observed, there is a tendency in the soil to become acid, and there is no other substance so capable of meeting this acidity, as lime.

Since the above was written, Judge Durfee has sent me fragments of impure anthracite, ploughed up from his fields. Whether it came from the rocks below, or is a portion of the diluvial matter on the surface, is not known, since the rocks are not exposed to view.

COMPTON PLAIN. The soil of this town rests upon granite rocks, and consists of a clayey loam, which is naturally moist and retentive. I examined the rocks and soils throughout this region, and particularly the farm belonging to Dr. Palmer, who politely assisted me, and furnished much interesting information respecting the usual methods of cultivation practised in the town.

The soil produces crops of corn, oats, potatoes, and barley. The grass lands yield on an average, one and a half tons of hay to the acre. The farmers in Compton have generally abandoned the use of fish manure, believing that it causes the soil to become sterile, or brings in red sorrel. This is the opinion of Dr. Palmer, who showed me a field which three years ago was treated with fresh fish very abundantly, and was then planted with oats. The grain ran up very tall, but did not fill well. Red sorrel now covers the whole surface of the field. Several other enclosures were shown me, where a similar result had taken place. Whatever may have been the cause of such a result, I am satisfied that a thorough liming will at once render the soil sweet, so that the sorrel will cease to grow upon it. I do not know why the fish should have produced such a result as it here appears to have effected, but in several instances I have found free phosphoric acid in soils that had been for many years manured with fish. The sorrel, however, contains the oxalic acid, and it may be that the phosphoric acid decomposed an oxalate of iron existing in the soil, oxalic acid being set free, may have furnished nourishment to the sorrel. Or it may be, that an acid or electro-negative soil favors the growth of sour plants. This is an important subject for the consideration of agricultural chemists ; but the analyses and experiments necessary for the satisfactory solution of the problem, would require a longer time than has been allowed me for the whole survey of the state. I selected several specimens of soil from the farm of Dr. Palmer, and below are the results.

Analysis of soils from Compton Plain.

Soil from the farm of Dr. Palmer—crop corn—manured in the hill with barn-yard manure, mixed with swamp muck.

No. 1. Pebbles,	186
2. Sand,	135
3. Loam,	679
	1000

Chemical analysis of 100 *grains.*

Water of absorption,	= 3.2
Vegetable matter,	10.1
Insoluble silicates,	78.5
Per-oxide of iron,	4.7
Phos. lime,	0.2
Magnesia,	0.1
Alumina,	3.2
	100.0

This soil is deficient in lime. It is quite argillaceous and retentive.

In Johnston, near Neutaconkanut hill, Mr. Daniel Pettis has an excellent farm, which is well cultivated, and very fertile. The natural soil being mostly the detritus of decomposed hornblende rock, is warm and retentive. The crops on this soil at the time of my visit were uncommonly luxuriant, especially the clover, which produced two tons of hay to the acre, without any manure having been spread on the land for two years.

Last year this lot produced oats, clover, herds grass, and red top. Potatoes are raised on three and a half acres of this land. A garden is also well cultivated, and yields an abundance of the root crops.

Analysis of the soil.

Mechanical separation.

No. 1.	Hornblende rock, sienite, and sticks,	30
2.	Fine particles of the same and sand,	33
3.	Fine loam,	937
		1000

Chemical analysis of 100 *grains of the fine loam.*

Water of absorption,	= 3.3
Vegetable matter,	9.5
Insoluble silicates,	78.6
Salts of lime,	0.7
Per-oxide of iron and alumina,	7.9
Magnesia, traces.	
	100.0

In Warwick there are numerous peat bogs, which can be easily reclaimed for cultivation, or may be made to yield both fuel and manure. Some of the peat is sufficiently compact for the former purposes, and many other bogs, by drainage, may be rendered solid also.

Numerous deposits of black swamp muck also exist in this town; and I have made chemical analyses of them, for the purpose of ascertaining their relative value as manures.

In Apponaug, there are three or four such deposits, that will furnish an unfailing amount of vegetable matter for compost. One of these bogs belongs to Mr. Josiah Wescott, who is preparing a compost from it, and has begun to cultivate the drained bog, so as to bring in English grass.

Another bog runs near Gorton's pond, on its western side, and there the peat is two and a half feet deep, and comprises about one acre, while the peat occupies but one quarter of the area. The largest deposit consists of swamp muck, of which there is a lot amounting to 20 acres on the estate of Joseph F. Arnold.

In the vicinity of Pawtuxet, there are also numerous deposits of excellent peat, suitable for fuel or for cultivation. Several of them have been wrought to a limited extent for fuel, and I saw some dried specimens of it which burn very well, but it leaves 32 1-2 per cent of ashes.

Messrs. Christopher and William Rhodes own several extensive and easily reclaimed peat swamps, that will give an abundant supply of fuel and compost manure. Some of the bogs belonging to them may be easily cultivated, and will produce more abundantly than any upland soils.

One of these bogs occurs near the road from Pawtuxet to North Kingston, and comprises about six acres, the depth being from five to fifteen feet in different parts of the bog.

WARWICK. The rocks upon which the soils on the eastern part of this town repose, belong to the grau-wacke series, and are mostly carbonaceous slates, and fine, compact grau-wacke. The soils are variable, being in some places the detritus of rocks similar to those upon which they rest, and in others of tertiary, diluvial or ancient alluvial origin. The light, sandy soils, covering a large portion of this district, are evidently different from the soil that would form from the rocks on which they rest, and must have been removed and deposited on them by the action of water. This detritus being composed mostly of sand, derived from the decomposition of granite rocks, must have originated in a region where they prevail, in a north westerly direction.

I obtained specimens of every kind of soil that I could discover, and submitted them to chemical analysis.

On the spring green farm, the residence of Governor Francis, the soil is a sandy loam, of easy tillage, and requires for its cultivation a fermented manure, which should be spread every season, since the soil is not very retentive. It may be much improved by admixture of clay, and could muscle mud be obtained, it would be one of the most proper amendments, furnishing both clay and lime to the soil. I collected and analyzed the various soils of this farm. (See tables of analyses of soils.)

I also examined a deposit of peat, which may be used for manure. There are about four acres of it, and the peat is two feet deep on an average.

Warwick Neck. On this peninsula the soils are generally good, and yield profitable returns to the farmer. On the estate of Capt. T. R. Holden, I examined the soils, and collected a number of specimens for analysis. The soils were derived from the decomposition of grau-wacke and slate rocks, are retentive, and produce excellent crops of potatoes and corn.

Analysis of soil from the estate of T. R. Holden.

No. 1.	Pebbles and slate,	147
2.	Sand, &c.	100
3.	Loam,	753
		1000

Water of absorption,	1.9	
Vegetable matter,	7.4	
Insoluble silicates,	85.2	
Alumina and oxide of iron,	5.0	
Salts of lime,	0.2	
	99.7	
	3	loss.
	100.0	

BOSTON NECK and POINT JUDITH have long been celebrated for the excellence of their soils, which are generally pretty stiff loams, owing to the presence of a large proportion of clay. The land is known to favor the growth of the sweet grasses, and rarely do the coarser kinds spring up.

I examined these peninsulas in detail, and collected specimens of the soils for analysis, as also samples of the peat, which occurs abundantly in quite regularly circumscribed deposits, on the Room farm, on the land of Mr. Carpenter, and on that of Mr. Updike, the latter being only six or eight inches deep, but it covers an area of 40 or 50 acres.

At Point Judith there are several peat swamps near the windmill, one belonging to Mr. J. H. Brown, 12 or 14 acres, 8 or 10 feet deep; and also near the light house.

Most of these bogs are shallow, and may be easily drained and cultivated, so as to become luxuriant meadows for English grasses, or the peat may be composted, as before mentioned.

On the farm of Mr. Willet Carpenter, opposite Dutch Island, there is a deep peat bog, comprising an area of four acres, and measuring more than 11 feet in depth.

Another bog was also examined, which was four or five feet deep, and comprised about three or four acres. This peat is of good quality.

Mr. Carpenter used peat for manure last year with very good results, the crop raised being indian corn.

Peat also occurs on the farm of Giles Pierce, where there are four or five acres.

Mr. Arnold Browning cultivates a farm on Boston neck. He says that he uses sea weeds, (kelp,) and rock weed, for manure. He composts the sea weeds in his hog yard. He has used but little fish manure, and does not think it brings in sorrel. The soil on his farm is a strong yellow-brown loam, and bears good crops of corn, potatoes, and rye.

The Room farm, at the northern extremity of Boston neck, is considered one of the best on the peninsula. Large crops of potatoes, oats, &c., were growing at the time of my visit. This farm comprises from 500 to 600 acres, is valued at $14,000, and is now leased to Mr. Benjamin Hazard. On the sea shore, in a creek, there is a bed of muscles, which furnishes a valuable manure, and it is used by Mr. Hazard.

He puts the muscles into his hog stye, and the swine break them up fine in the course of a week or two. He then uses them for manure, and they act favorably, owing to the animal and the calcareous matter which they contain.

Mr. J. D. Austin says that the corn crops vary from 20 to 60 bushels, the average being 30 bushels to the acre. He says that no fish manure is used on Boston neck, but they use eel grass, rock weed, and barn yard manure. The former are preferred for potatoes, and the latter for corn.

Point Judith is celebrated for its large crops of potatoes, and I was informed that one family raised no less than from 16,000 to 20,000 bushels per annum, on 500 acres of land, the crop being 300 bushels to the acre.

South Kingston produced 75,000 bushels of potatoes. This is the most profitable crop in the town, and large quantities are sold from 25 to 30 cents per bushel, and are exported.

Boston Neck and Point Judith are both capable of being rendered vastly more fertile than they now are, by more thorough tillage, and application of composted manures. Lime would doubtless be a useful top dressing, for I was informed that where a cask of shell lime had been spread, that a great increase of the crop ensued. (See analysis of these soils in the annexed tables.)

Cranston. The Rivulet farm, belonging to Hon. William Rhodes, has abundant deposits of excellent peat, which is from 10 to 20 feet deep, and sufficiently dense for cultivation of its surface. The peat will serve admirably for composting, and is suitable for fuel. It comprises an area of 10 or 12 acres.

100 *grains of the dry peat analyzed, yielded,*

Vegetable matter,	87
White ashes,	13
	100

The ashes consist of

Silica,	8.0 grs.
Alumina, oxide of iron, and manganese,	2.2 "
Phosphate of lime,	2.8 "
Potash, a trace.	
	13.0

(See analysis of the vegetable matter.)

On the Rivulet farm, irrigation is practised to some extent with apparently good effect. (See Mr. Rhodes's farm report appended. No. 5.)

Peat also exists abundantly on the estate of Mr. Henry King, and on that of Mr. Henry Baker, who owns about 12 acres of bog.

At Natick, Mr. Burton Baker has about two acres of peat land, where the deposit is 20 feet deep.

Centreville. Flat pond meadow has a thin layer of peat, or swamp muck, covering an area of five acres. This land has been tilled and laid down to grass. It yielded 10 loads of hay, (herds grass and red top,) equal to three quarters of a ton to the load. The subsoil on which this peat rests, is a yellow, micaceous, sandy clay, which retains moisture, and requires drainage.

I visited the farm of Mr. Allen, who said that he found grass crops to be the most valuable on his farm. He tried to raise wheat this year, but the crop was blasted, and was not worth threshing. It appeared to have suffered from mildew and rust.

Mr. Allen has tried fish for manure, using two menhaden to each hill of corn; but as he thinks, without any advantage.

He says that his brother also injured his garden by spreading fish liberally upon the soil.

Dr. Harris says that he had used fish on his land, and that they did no good the first year, but he thinks the grass lands were better for this application the next season. They were spread in the middle of May, last year.

I give the above statements to show how various are the opinions of farmers respecting this manure, and it is probable that there may be some differences in soils that serve to account for the fact; but in many cases there must be some prejudice from accidental failures.

North-Kingston. I visited the farm of Mr. Joseph Sanford, near the village of Wickford, in N. Kingston, and there had an opportunity of seeing fairly demonstrated the immense agricultural value of peat and muck compost, in the treatment of the soils of Rhode-Island. This gentleman showed me his cultivated fields, where he was making experimental trials to ascertain the relative value of peat compost and hog-pen manure. The result even then was strongly in favor of the compost, and it has proved to be so at the harvesting of his crops, as I have since learned by visiting his farm late in the autumn. The experiment was tried on various crops, and I shall first remark on the corn-field. This field was observed to be quite uniform in the appearance of its soil, and was nearly level. Across the field, in two directions, at right angles with each other, Mr. Sanford had tried the two manures, and it was therefore a fair experiment, so far as regards the soil.

Eight loads of the compost which I shall describe, were used per acre in the hills, and the same proportion of hog-pen manure was used in the same manner. It was easy to mark the places where the compost had been used, since the young corn was in each hill four times as high as in the others, and of corresponding strength, and the plants would apparently weigh eight times more than on the other part of the lot. At harvesting, it was ascertained that there was a gain of 50 per cent in the corn crop, where the compost had been used.

The compost in question was made as follows. In the corner of the field a cleared and level spot was rolled down smooth and hard, and the swamp muck was spread upon it, forming a bed eight feet wide, about 15 or 20 feet long, and nine inches thick. For every wagon load of the muck one barrel of fish was added, and the fish were spread on the surface of the muck, and allowed to become putrescent. The moment they began to decompose, he again covered them with peat, and a renewed layer of fish was spread and covered in the same manner. The fermentation was allowed to proceed for two or three weeks, when the compost was found to have become fit for the land.

Mr. S. is of opinion that such compost may be made a season beforehand, beginning in the autumn, and allowing it to remain all winter. It ought, however, to be rounded up, and covered with a thatching of straw and slab boards, so as to prevent the rain from washing out the valuable soluble salts that form in it.

I also advised the application of a cask of lime to each load of the compost, and this may be put in as early in the spring as convenient, and will complete its action in two or three weeks. By this operation the value of the compost may be more than doubled. If there should be any quantity of gaseous ammonia given out, the heap may be covered with more swamp muck or peat, which will absorb it entirely, and become a valuable manure. Peat and fish both contain phosphoric acid, and the lime combining with that acid, forms phosphate of lime, which is the same as bone manure.

It also combines with several other acid matters existing in peat, and forms soluble and fertilizing salts of great importance. At the same time, the lime causes the fibrous matter of the peat to undergo a more complete decomposition.

It is so easy to make this compost, that I doubt not farmers will gladly avail themselves of their peat bogs, and that great improvements will hence arise in the cultivation of soils.

Respecting the cost of the above described compost, Mr. Sanford remarks, that it costs only one third the price of ordinary manures. His crops, the present year, have been much injured by the late gales of wind, so that he only obtained 700 bushels of corn from 30 acres of land, 2000 bushels of potatoes from 16 acres, and three quarters of a ton per acre of hay. A large portion of the land, he observed, had not been manured.

Mr. S. has used various other manures, such as eel grass, rock weed, ribbon weed, &c., but prefers peat composts to all other substances. He says he would not use eel grass if he could obtain it for nothing. Rock weed, five or six years ago, cost here from 50 to 75 cents per load, but now sells from $2,50 to $3,00. The distance to which it is required to be hauled by team is one and a half miles.

Mr. Sanford says that he can make 1000 loads of compost for the sum that it formerly cost him to obtain 250 or 300 of ordinary manure.

He has used the swamp muck alone on his soils with good results, especially in the cultivation of potatoes. Sixty loads of it spread upon the acre, is stated to have doubled his crop of corn the first year. He thinks that the peat prevents worms from attacking turnips.

The following experiment was tried with fish and rock weed, used in alternate rows across the field.

Corn was planted, and the crops were equal in amount, and were both good. The next year he sowed oats on the lot, which gave a good crop at harvesting. The third year he laid the field down to clover, which he cut for two years. He remarked that where the fish manure had been spread, the clover ran out entirely, and it remained on that portion of the field where rock weed had been used. This fact is important to the farmer who intends to lay down his ploughed land to grass, and it will be very desirable to ascertain if it is a common result. So far as my observations have gone, it appears that fish used alone is a very powerful and valuable manure, but transient in its effects, and where used without previous composting, it leaves the soil impoverished and acid. The introduction of lime, ashes, and vegetable matter, mixed in compost with the fish, is highly desirable.

Peat and swamp muck are composed of the same vegetable matters, but vary in respect to their proportions of earthy substances.

Peat forms from the decay of certain low land mosses, and aquatic grasses, ferns, and dead stalks, all of which undergo decomposition, as it is modified by submersion in water. Swamp muck is formed from the wash of uplands, dead leaves of trees and other plants, mixed more or less with the peat mosses. The muck has but one advantage over peat as a dressing to land, and that is its fine division; but it is really much poorer in vegetable matter than the average peats.

By chemical analysis, Mr. Sanford's peat yields 88 per cent of vegetable matter, 12 per cent of ashes, composed of the phosphate of lime, free phosphoric acid, silex, alumina, and a little manganese and iron.

The swamp muck contains from 60 to 70 per cent of similar vegetable matters.

Analysis of soils from the farm of Joseph Sanford, of Wickford.

No. 1. Soil dressed with hog yard manure, eight loads to the acre, in the hill. Crop, indian corn.

No. 1.	Pebbles,	= 31
2.	Sand,	147
3.	Loam,	822
		1000

Chemical analysis of the fine loam.

Water of absorption,	= 2.1
Vegetable and animal matter,	5.6
Insoluble silicates,	84.4
Per-oxide of iron and alumina,	6.9
Salts of lime, mostly phosphate,	0.7
	99.7
	3 loss.
	100.0

No. 2. Same soil treated with swamp muck and fish compost, in same quantity as the above, in the hill.

No. 1.	Pebbles,	23
2.	Sand,	129
3.	Loam,	848
		1000

Chemical analysis of the fine loam.

Water of absorption,	= 2.2
Vegetable matter,	6.1
Insoluble silicates,	85.5
Per-oxide of iron and alumina,	5.5
Salts of lime, mostly phosphate,	0.6
	99.9
	1 loss.
	100.0

The soil in both these instances was taken half way between the hills, and the analyses were made in order to ascertain if there was any real difference in the soil, since the crops were so very different, the young corn being vastly more forward on the soil No. 2, than on the other portion of the field, where animal manures had been used.

South Kingston. In this town there is an immense deposit of peat, situated north west of Worden's pond, on the neck of land between the head branches of Pawcatuck stream.

There is an area of more than 1100 acres of peat in this place, and it varies from 3 to 30 feet in depth.

The great neck comprises about 500 acres of land, and there are cedar swamps full of deep peat bogs. The swamp surrounding the neck contains 1000 acres. The cedar swamp bog being examined, was found to be three or four feet above the level of Worden's pond, and the peat is not less than 12 feet in depth.

I took specimens of a number of lots of soil, and of the peat, for chemical analysis.

Lyman farm, owned by Governor Arnold. The top soil of the potato field is of a greyish color for about six inches in depth, and the subsoil is found to be yellow for 10 inches, and the whole rests upon a hard pan of fine sand and clay.

Gov. Arnold has made some experimental trials to ascertain the best manures for his land, and I had an opportunity of viewing the experiments in progress.

Comparison of stable manure and peat. Eight loads of peat was dug last fall, and one cask of lime was mixed with it, and then it was allowed to remain until spring, when it was turned with the hoe. This was tried against equal quantities of stable manure, a shovel full of each being placed in separate hills, the crop being potatoes. I examined this field, and could not discover any difference in the appearance of the vines. Where bone dust had been used, a handful being thrown into each hill, the crops were compared with those on stable manure, and it was evident that the plants were more forward on the manure, but the vines were of a much deeper green on the ground bone. I have not learned the results since the crops have been obtained.

Experiments were tried with potash, 200 weight being dissolved in 20 barrels of water, was sprinkled over an old run out meadow, but it did no good whatever. He has used ashes with success.

Lime alone was spread on some soil near the house, and no perceptible effect was discovered.

It is not known whether the lime was of the magnesian variety.

Chemical analysis of soil from Gov. Arnold's potato field, Lyman farm, South Kingston. No manure. Soil dark brown.

Mechanical Separation.

No. 1.	Sienite and granite pebbles,	63
2.	Sand, straws, &c.,	94
3.	Fine loam,	843
		1000

Chemical analysis on 100 *grains of the fine loam.*

Water of absorption,	= 2.9
Vegetable matter,	11.0
Insoluble silicates,	80.6
Alumina and per-oxide of iron,	4.7
Phosphate and crenate lime,	0.5
	99.7
	3 loss.
	100.0

(See tables for other analyses.)

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AGRICULTURAL OBSERVATIONS

ON THE

ISLAND OF RHODE-ISLAND.

The island of Rhode-Island is generally remarkable for the fertility of its soils, which are chiefly derived from the decomposition and disintegration of grau-wacke rocks, and their accompanying slates; while in a few instances we find diluvial matter mixed with them, that must have originated from rocks to the northward of Providence. One of the most valuable properties of these soils, is their retentive power, owing to an admixture of clay derived from the slate rocks that occur abundantly in the island. At Portsmouth, much of the soil is indigenous, or was formed directly from the slate rocks below, as may be seen near the ferry, and along the whole extent of the coal basin.

The farm of Judge Childs is situated in Portsmouth, on the eastern side of the island, near the sea shore, and is cultivated in the most successful manner. I visited this farm, and was most politely received by its intelligent and hospitable proprietor, who furnished me with all the statistical information that was desired, and has since sent me a detailed account of the management of his farm, which is herewith presented. I collected several specimens of the most important soils which he cultivates, and have submitted them to chemical analysis, a report of which will be found in the appended tables.

Judge Childs makes use of great quantities of fish for manure, generally composting them with sand, which is applicable, since his soils are naturally clayey and tenacious. He also avails himself of all the vegetable matters that he can obtain, and uses them in compost. Thus all the weeds which he pulls up are made to add to the fertility of the soil, since they are thrown into the hog pen, and there being composted, are converted into manures, and are then returned to the land.

I selected three fair specimens of soils from this farm, which have been analyzed in my laboratory, and the results are herewith given in the tabular view of the composition of soils.

(See Judge Childs's farm report. No. 4.)

Judge Childs uses lime freely in preparing his land for wheat, and with uniform success; the crops varying from 30 to 35 bushels to the acre. I examined one of his fields of winter wheat, which was then just ripe, and appeared to be of good quality, the grain being full, heavy, and free from smut. On a lot adjoining the wheat field, he cut about two tons of hay to the acre, and the year before last obtained 30 bushels of rye per acre from the same lot.

He keeps an exact account of the expenses and receipts of his agricultural business, as every good farmer ought to do, and his accounts showed a clear gain of $1000 per annum, which is a large profit considering the small size of the farm, and is due chiefly to his excellent management, for the farm was not profitable until it was judiciously manured.

At the southern extremity of the island, there exist great natural advantages in obtaining sea manures, for the spoils of the ocean are thrown up in immense quantities upon the shore by the surf, which breaks upon the rocks during south easterly gales with great fury, tearing up the marine plants adhering to submarine ledges, and casting them upon the shore mixed with various corallnes and shell fish, that occur with them. On the farm of Mr. N. S. Ruggles, near Newport, there is one spot of sea-coast, only one hundred yards in extent, upon which the surf annually throws no less than $500 worth of sea-weeds, such as narrow leaved kelps, or ribbon weed, rock weed, carrageen moss, eel grass, and sea coral.

The farm cultivated by Mr. Ruggles is very fertile, and is valued at $180 per acre. It produces heavy crops of grass and grain, and is well cultivated. The soil appears to be a good loam, underlaid by clay, that may be seen cropping out near the shore. (See analysis of Mr. Ruggles's soils in the tables.)

Sea manures being easily obtained in the vicinity of Newport, are used extensively and almost exclusively by the farmers. There are, however, a few deposits of peat, that may be of some importance in the formation of composts. Peat may be mixed with rock weeds in the hog styes, and will make a more permanent manure. It ought, however, to be limed before it is put upon the soil. The peat bogs to which I refer, are found near the lily pond, on the rocky farm at the south extremity of the island.

A shallow, but very extensive deposit of swamp muck, also occurs in Dyer's swamp, near the base of Miantonomah hill, situated north of Newport. This estate, I was informed, belongs to Mr. William Rodman. It now lies wholly barren, or is only covered with bushes, and rank aquatic rushes and grasses. By drainage, effected by means of border ditches draining to the north, this tract of land may be easily reclaimed, and may be converted into a very rich meadow.

So large and important a tract of land in the vicinity of Newport, ought not to remain neglected, and I hope the owner's attention will be called to it.

This swamp muck may be collected and composted in the same manner as peat, with fish or any animal matters, and will become a very valuable manure, especially if lime is mixed with the compost.

Castle Hill farm possesses admirable sea manure privileges, and immense quantities of ribbon weeds, carrageen moss, rock weeds, and coral, are thrown upon its shore by the surf, and furnish an unfailing supply to the industrious farmers.

These matters are very valuable manures, and I therefore took some specimens of them for analysis. Sea coral contains the following ingredients in 100 grains.

Animal matter,	14
Carbonate of lime,	85
Phosphate of lime,	1
	100

5 oz. 70 grs. of green ribbon weed was dried by Mr. Owen Mason, in a warm garret, during the hot weather of summer, and when dry it weighed 1 oz. 70 grs., so that he ascertained that four-fifths of its substance was water. This dry kelp was then given to me for analysis, and after washing it clean in distilled water, which removed a crust of salt, it was again thoroughly dried, and then analyzed by burning a given weight of it to ashes, and then separating the principles that the ashes contained. I obtained from 400 grains of the dry kelp,

Carbonate of soda, not weighed.	
Phosphate of lime,	= 3.3
Carbonate of lime,	2.0
Silex,	0.2
Magnesia,	3.5
Grs.	= 9.0

The solution tested by means of a few drops of nitric acid, and a glass rod dipped in a solution of starch, gave a violet color, indicative of the presence of a small quantity of iodine, that was originally combined in the plant with the magnesia or soda.

Ribbon weed, or narrow kelp, when it is composted, melts down into a mucilaginous mass, becoming very hot during the fermentation.

The Scotch farmers make great use of this substance, and prefer laying it directly on the soil while in its green state, so as to allow it to give out gradually its mucilaginous matters. On Rhode-Island, it is used both in its natural and composted state.

Carrageen moss is composed of a gelatinous matter, possessing some properties analogous to animal gelatine. It is largely used for food, and makes a delicate *blanc-mange.* It might perhaps be used as a food for young animals, as it will dissolve readily if boiled with milk, and it is so abundant on Rhode-Island that many hundreds of loads are obtained per annum for manure.

Sea coral is thrown up abundantly on the shores of Newport neck, and I found that the farmers regarded it as a very valuable manure.

I visited the farm of Mr. Bateman, on the point south of Newport, and obtained from him some important information.

His farm consists of 342 1-2 acres, and is profitably cultivated. Mr. Bateman uses both sea and fish manures, and prefers fish when he can obtain them for one shilling per barrel.

He uses from 30 to 90 loads of eel grass, ribbon weed, and rock weed manure to the acre, and considers this manure best for his grass lands, while he prefers barn yard manure for his corn fields. He thinks that the effects of sea manure do not last longer than three years.

His farm produces excellent crops of corn, from 30 to 50 bushels to the acre. Oats and barley do well. Wheat is not a successful crop with him, as he obtains but seven bushels to the acre.

His potato crops average 250 bushels to the acre. Mangel wurtzel from 1700 to 1800 bushels to the acre. Turnips do not grow well. The worms injure them very much.

His grass crops amount to one and a half tons of hay to the acre, mostly fine and red top.

The sea privilege along the shore is very important, upwards of 3000 wagon loads of marine weeds being thrown up per annum, on an extent of only one and a quarter mile of coast. The sea weeds are worth on the shore one dollar per load of two tons weight.

I visited several good farms north of Newport, collected specimens of the soils, and noted all the facts I could learn concerning their management, and the crops which had been obtained.

The farm of Captain Northam, is one of much interest on account of the improvements that have been made upon it by its ingenious and enterprising proprietor.

The land consists of 100 acres, and was a few years since, when purchased by its present owner, nearly exhausted, producing insignificant crops, so that it was far from repaying the expense and labor of tillage.

The first year after Captain Northam purchased it, he states that one of the four acre lots, of which he had taken special note, yielded but one ton of hay; equal to a quarter of a ton to the acre. He then spread upon this field 200 loads of manure, and obtained a crop of 200 bushels of indian corn, equal to 50 bushels to the acre, which repaid the expense of manuring the field. On the third year he spread on the same soil 300 bushels of leeched ashes, and raised a crop of barley that amounted to 200 bushels, or 50 bushels to the acre. The land being then laid down to grass, yielded on the fourth year eight tons of hay, equal to two tons to the acre. The soil was thus brought into a fertile state, and will richly repay the labor and expense incurred in its improvement.

The stock kept on this farm consists of 20 head of cattle and 200 sheep, besides which a great number, not less than 300, barn yard fowls are also reared.

Among the curious and useful agricultural implements contrived by Captain Northam, is a hay spreading machine, which will scatter the cut grass on a field, spreading eight tons of hay in an hour and a half, the machine being drawn by oxen, and driven by a boy. It was stated that this machine would on level ground perform the work of eight men. It consists of a frame having two wheels, and a drum filled with long iron rake teeth, the drum being moved rapidly by means of a gearing connected with the wheels, which is also arranged in such a manner that the machine may be turned round, the wheels revolving in opposite ways, while the drum moves steadily in the same direction as before. It is rather difficult to give a clear idea of it, without detailed drawings, which will not be expected in a work like the present.

Judge Clarke's farm, near Kendall's mills, was also examined. The land amounted to 142 acres, and is said to be a good and profitable farm.

I selected specimens of the soils, and have analyzed that taken from the wheat field, where a good crop of grain was growing at the time of my visit. This soil had been prepared for the wheat crop by spreading upon it 100 bushels of leeched ashes to the acre. (See analysis of this soil, No. 44 of the tables.)

The corn crops on this farm were represented to be on an average from 30 to 40 bushels per acre.

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REMARKS ON THE IMPORTANCE OF THE CHEMICAL ANALYSIS OF SOILS.

All intelligent agriculturists will acknowledge that the first step in the improvement of a soil, consists in learning its composition, so as to be able to compare it with other soils remarkable for their fertility, or for the production of peculiar crops.

After obtaining such information, it is evident that we may, by proper applications of the required ingredients, bring the soil to the standard of any other variety, the only question being whether it can be done economically by means of the resources within our reach.

On comparing the analyses of the soils of Rhode-Island with each other, and with those of other countries, which I shall present in this report, it will be seen that the changes which are to be effected in the composition of comparatively barren soils, in order to render them fertile, are generally attainable, and by skilful and scientific methods we may always feel sure of a favorable result.

It is too generally true that our agriculturists have experimented blindfold, and but little true scientific knowledge results from such operations.

Hence we find the most contradictory accounts of nearly every method of improvement. If we consult the experience of others, as recorded in books and agricultural newspapers, the information is by no means to be relied upon, unless all the conditions of the problem are fully stated; and above all it is essential that we should know the composition of the soil on which the operations were performed, so as to be able to institute a comparison with that on which the experiments are to be repeated.

In order to illustrate this remark, let us suppose that one of our farmers had read of one of the methods of improvement employed extensively in Belgium, where pyritiferous lignite is spread over the surface of the soil, for the purpose of generating sulphate of iron, a substance that reacts continually upon a calcareous soil, liberating carbonic acid gas, and forming sulphate of lime, or gypsum, both of which serve to render vegetation luxuriant, the carbonic acid gas being absorbed by the foliage, while the gypsum stimulates the plant to its rapid absorption and assimilation. The fact being published without any chemical explanation, and the resulting crops being stated, it is perfectly natural to suppose that an enterprising New-England farmer would be disposed to try such a promising experiment on his soil, if he could obtain the substance mentioned. Now it is absolutely certain, that the very substance that confers fertility on the calcareous soils of Belgium, would render any New-England soil utterly barren, so as to be irreclaimable without chemical skill, and large expenditures.

Sulphuric acid and copperas are used in England for the purpose of decomposing vegetable fibre in composts, and such a compost is found to be very proper for calcareous soils; but it would actually destroy every vestige of vegetation on our silicious soils.

We are in constant danger from such errors, unless we know the composition of the soils where the experiments were made, and also the nature of the soil where it is to be repeated.

Such knowledge is not only useful by teaching us how to avoid erroneous practices, but is also a sure guide to agricultural improvements, and must be made the basis of the art. Empyricism ought not to be the only means of improvement with an intelligent farmer. Mere experience without scientific light is at best uncertain, and we consider the union of theory and practice as the grand desideratum in the art. Every American farmer who prides himself on his freedom and intelligence, should exert himself to rescue agriculture from a mere routine of mechanical drudgery, and should endeavor to instruct his children in the scientific principles of the art. Besides increasing the agricultural produce of the country, such means will surely aid in the advancement of civilization, and will afford a constant source of rational enjoyment to the intelligent, educated farmer. I do not understand why the agricultural community have been so long willing to forego the benefits of a scientific education, nor why they have not established colleges or schools for instruction in the principles of this, the first and most important of the arts.

MECHANICAL SEPARATION OF THE PARTICLES OF SOILS.

The relative proportions of coarse and fine detritus entering into the composition of soils, should be known, in order more fully to understand their properties. By means of the most simple methods this knowledge may be readily attained, and any person may perform the operations required. The only instruments needed are two sieves, one made of copper wire, with meshes one tenth of an inch square, and another sieve of fine gauze, having meshes a fiftieth of an inch in diameter. Those brought to this country from Canton, and sold in the apothecaries shops, answer perfectly for this purpose.

A glass jar, or a common clear glass bottle, will also be required, for washing out the coarse and fine particles, so as to detect the nature of the simple mineral ingredients. An ordinary balance, capable of turning with a grain weight, and a set of weights from 1 to 1000 grains, will answer for weighing the relative quantities of coarse and fine matter.

Having dried the soil, rub it so as to break down all the lumps, and then weigh out 1000 grains. Sift it through the coarse sieve, and what remains too coarse to pass its meshes, weigh and mark it No. 1. This will consist of pebbles and sticks; and the pebbles being broken on an anvil, their nature may be ascertained by inspection.

Sift the soil that had passed the first sieve, on the fine gauze sieve, and weigh the matter remaining in it. This will be found to consist of sand and fine vegetable fibres. Mark it No. 2.

The fine powder that passes the gauze sieve may be marked No. 3, and the weight of each is to be noted.

Having finished the sifting operations, we may separate the fine particles again by agitation with water, a given quantity of the soil being employed with a certain measure of water. Agitate the mixture for a few moments, and turn off the suspended matter. This will consist mostly of the vegetable substances, clay, and fine sandy particles. Examine the residue in the glass jar after having washed away the fine particles, and you will perceive the larger particles of the mineral components. By collecting these washed materials on counterpoised filters, it is easy to determine their relative proportions.

The above operations are simple and of easy execution, so that any farmer can repeat them, and may obtain some valuable information thereby.

CHEMICAL ANALYSIS OF SOILS.

Although I am fully aware of the fact that an art so difficult as chemical analysis cannot be practised by a farmer, whose avocations will not allow him time to acquire the requisite degree of skill, still there may be some advantage in describing our methods, since some persons of leisure may be disposed to learn the art, and a description of the processes actually pursued in the examination of the soils of Rhode-Island, cannot fail to prove interesting to those whose soils have been subjected to these operations.

I do not consider that any thing short of a thorough and complete analysis, can prove serviceable to agriculture, and hence reject all short hand methods as inadequate. The methods proposed in Sir H. Davy's Agricultural Chemistry, and in Chaptel, will answer for the mere detection of the principal ingredients, but no chemist will now think of following them in a proportional analysis.

METHOD PURSUED IN THE ANALYSIS OF THE SOILS OF RHODE-ISLAND.

1. Having weighed out a certain quantity, say 100 grains of the fine soil, that has passed the finest sieve, it being weighed upon a square piece of glazed letter paper, the first step is to dry it thoroughly at a temperature above boiling water, but not sufficient to scorch the paper. The soil being again weighed, its loss of weight is water, and the amount is noted in the laboratory journal, A.

2. To ascertain the quantity of organic matter, whether of vegetable or animal origin, we place the dried soil in a platina crucible, cover it closely, and heat it gradually to redness, over an alcohol lamp. By the odor disengaged during the process, we know whether the organic matter is of a vegetable or animal nature, the former having the smell of burning peat, and the latter that of burnt feathers. It is, however, difficult to distinguish the mixed odors, without much practice. Having charred the organic matter, it may now be safely burned out, by placing the open platina crucible with its contents in a clay muffle, open at one end, and exposed to a full red heat. The air circu-

lates in this muffle, and soon burns away all the organic matter, which may be ascertained by repeatedly stirring the soil with a platina rod during its combustion, and noting whether any more particles are burning. After the operation is complete, weigh again, and the loss of weight is the amount of organic matter in the soil. Note it in the laboratory journal, B.

3. To determine the amount and nature of matters soluble in muriatic acid, which will take up all the mineral substances that can be acted upon by vegetation, such as all salts of lime, iron, alumina, manganese, magnesia, potash, &c., place the burned soil B in a clean green glass flask, with a thin bottom, pour over it a small quantity of distilled water, sufficient to cover it, then drop in some muriatic acid, and note whether there is any effervescence. If so, there is a carbonate, probably of lime, in the soil. Add more acid, say about one ounce, diluted with an equal bulk of water. Boil the whole, for half an hour, or until the residuary matter is nearly white. Every thing soluble in the acid is then taken up. Dilute with distilled water and throw the whole upon a double filter. After the liquid has passed through the paper wash the insoluble matter on the filter by means of a stream of boiling hot water, and continue the operation until the water comes through tasteless. Dry the filters with their contents, separate them and burn them separately, weighing one against the other. The difference is the weight of the insoluble silicates, and is generally nearly pure silex. Note its weight, C.

4. In order to ascertain the nature and proportions of the matters that have been dissolved by the muriatic acid, you may proceed as follows:

Take the filtered solution, which must be in a green glass flask; add to it a few drops of nitric acid, to peroxidize the iron, and boil it. Then, while still warm, add liquid ammonia, until all the per-oxide of iron and alumina are precipitated. Simmer the whole a few minutes so as to condense the bulky precipitate. Filter on double paper, wash the precipitate 12 hours with hot water, or until the liquid passes tasteless ; then separate the precipitate while moist from the filter by means of a silver knife, scraping up every portion that can be removed from the filter. Place this in a large silver crucible and pour over it a solution of pure potash, in distilled water. Boil until the alumina is entirely taken up, and the oxide of iron left has a deep brown color. You may know that a sufficiency of potash has been added by letting fall into the solution a drop of muriatic acid, when flocculi of alumina will precipitate, but will immediately redissolve if there is potash enough. Dilute with distilled water, filtrate through double filters, wash the precipitate, dry the filters and their contents, separate them, and burn and weigh them against each other. The difference of their weight is that of the per-oxide of iron. Mark its weight against D.

5. To separate the alumina, you must now take its alkaline solution and acidulate it with muriatic acid ; then add a solution of carbonate of ammonia in pure water. All the alumina will be thrown down in the state of a white, gelatinous, and flocky precipitate. Collect it on a double filter, wash it for 24 hours with boiling distilled water, dry it, separate and burn the filters. Weigh one against the other, and the difference of their weight will be the weight of the alumina. Mark this against E.

Now you may go back to the ammoniacal solution, from which the iron and alumina have been separated, but in practice the following processes are carried on while we are waiting for the filtrations and washings of the alumina and oxide of iron.

This ammoniacal solution may contain the lime, magnesia, and a small quantity of manganese. Add to it a solution of oxalate of ammonia which will precipitate all the lime in the state of an oxalate. Let this precipitate subside, and then collect it on double filters, washing it with warm water. Dry the filters with their contents, separate them and burn one against the other at a red heat in a platina capsule ; let fall a few drops of a solution of carbonate of ammonia upon the lime, heat it again to dull redness. Weigh the result against its counterpoised burnt filter, and you will have the quantity of lime in the state of a carbonate, and may reduce it by calculation to any other salt of lime that you have found to exist in the soil. Mark the weight of this against F.

6. To separate the magnesia, add to the solution from which the lime has been separated, a solution of phosphate of soda, (it being still ammoniacal,) when the magnesia will be thrown down in the state of an ammoniaco-magnesian phosphate. Collect it on a filter, wash it but little, then dry the filters and contents, separate them, burn one against the other in a platina capsule. The difference of weight will be the weight of the bi-phosphate of magnesia, 40 per cent of which may be regarded as equivalent to the magnesia contained. G.

7. You may now run a current of sulphuretted hydrogen gas through the remaining solution, or add bi-hydro sulphate of ammonia, when all the manganese will be thrown down in the state of a sulphuret. Collect and reduce it to black oxide. H.

The analysis is complete so far as it can be done on this specimen, and you may sum up your results, and see how nearly they will balance, and if there is a loss, you must make another examination for salts of potash and soda, in the manner I shall give presently. Let us first sum up the above operations.

A Water of absorption.
B Organic matter.

C Insoluble silicates.
D Per-oxide of iron.
E Alumina.
F Lime.
G Magnesia.
H Manganese.

In order to ascertain the existence of alkaline salts, burn off the vegetable matter from another 100 grains of the dry soil. Then pour over it a little nitric acid, and digest it at a boiling heat. Dilute and filter the solution, evaporate it to entire dryness, fuse the saline matter obtained, and drop into it a few fragments of prepared pure charcoal. If nitrates are present, deflagration will take place, and the alkaline bases will be converted into carbonates. Dissolve the residue and test a drop of the solution by means of a solution of chloride of platina and soda. If potash is present, a yellow powder will precipitate, but none will fall if soda alone is present.

There is generally only a mere trace of alkaline matter in the soils of Rhode-Island, and its quantity can only be determined accurately by operating on 1000 grains of the soil. The per centage may be inserted in the above summary.

Products from the putrefaction of organic matters on the surface of the earth or in the soil.

When dead organic matters, whether of vegetable or animal origin, are exposed for a season to the action of air and moisture, they undergo chemical changes, and are converted into a brownish or black mass that is called Humus.

Berzelius, in his *Traite de Chimie*, tome vi. pp. 570 to 583, gives a detailed account of the researches that have been made upon this substance. He calls the portions soluble in water, Extract of Humus, and the insoluble matters, Geine, Apothem, and Carbonaceous Humus.

Bracconnot described these substances under the name of Ulmine, considering them identical with the extract discovered by Klaproth in the bark of the elm tree, and also included under the same name the brown extractive substance formed by fusing saw dust with potash. (See Berzelius, tome vi. p. 240. Paris, 1832.)

Much confusion appears to exist as to the nature and names of the organic matters contained in soils, and it is probable that in the several stages of decomposition of different substances, a variety of changeable compounds are produced that have not yet been fully examined. But the final result of their natural changes in the soil, is the production of apocrenic and crenic acids.

During the last year I have endeavored to ascertain the nature of the extractive matters obtainable from the Humus of soils and from peat, and have ascertained that the principal mass of those substances to which the names Humus, Geine, and Apothem, have been applied, is a compound of the crenic and apocrenic acids, which are in part combined with bases, such as the per-oxide of iron, manganese, lime, and magnesia.

The soluble extract of Humus is mostly composed of crenic acid, sometimes combined with lime and per-oxide of iron. Berzelius first discovered these new acids, in the waters of Porla Springs, in Westrogothie, Sweden, but subsequent to the publication of his *Traite de Chimie*, so that we may set aside the former names, Geine and Apothem, and adopt those which should now be applied, since it is evident on comparing the two accounts of the Porla waters, as described by Berzelius, that the matters formerly confounded under the names Extract, Geine, and Apothem, are identical with the crenates and apocrenates, subsequently detected. After the discovery of these acids in the soils and peats of Maine, Massachusetts, and Rhode-Island, I had the curiosity to examine soils from the continents of Asia, Africa, and those from the West-Indies, and from the western states of this country. In all of them I have discovered crenates and apocrenates. I have also detected the crenic acid in various waters from lakes, rivers, and wells, so that there can be no doubt of its being generally present in arable soils.

After the discovery of these acids and their combinations, it was easy to devise methods for their separation.

The method pursued by Berzelius in the analysis of the Porla ochre, was inadmissible in this case, since potash dissolves also alumina and fine silica, besides decomposing several saline compounds that occur in soils, and those matters would embarrass the operation. Alkaline carbonates are decomposed by the crenic and apocrenic acids, and the alkali combines with them, hence I made use at first of a dilute solution of carbonate of potash, as recommended by Dr. Dana. It was, however, objectionable, since it is impossible to wash out the last traces of the carbonate of potash from the vegetable fibre, and from the aluminous matter of the soil, and the subcarbonate of potash takes up a portion of the alumina, so that the process was found to be inexact.

I then resorted to ammoniacal salts, and found that a saturated solution of carbonate of ammonia would take up all the organic matter that was in a state suitable for the nourishment of plants, and that very exact comparative researches could be made by means of it, since every trace of carbonate of ammonia could be washed out of the soil, so that the true loss of weight could be exactly known. This process is also above any suspicion, so far as its decomposing powers are concerned, and cannot change the composition of an organic substance so as to produce another, as is the case with strong potassic solutions.

All the subsequent steps of the analysis are rendered comparatively easy and exact.

When engaged in a series of comparative trials of many soils, the chemist selects a number of glass flasks of the appropriate size, marks them by numbers, and puts into each the same weight of soil. Then a large quantity of pure carbonate of ammonia is dissolved in water, which is saturated with it at the ordinary temperature. A measured quantity of this solution is poured into each of the flasks, and they may then be all digested for the same length of time at the same temperature.

Thus the results of this process will be found strictly comparative, and with ordinary care no error of more than one tenth part of a grain, or one thousandth part of the charge, need be committed. Ammoniacal salts are always preferred in analyses when they are applicable, and they are most fortunately so in the operations that I shall describe.

Crenic Acid.

Crenic acid was discovered by Berzelius, in 1832. It derives its name from the Greek, *Krene*, a fountain, it having been first discovered in the waters of Porla Well, in Sweden.

Apocrenic means from the crenic, it being discovered with it. These acids were formerly considered by Berzelius under the name of Extract of Humus, (*extrait de terreau*,) and he states that when evaporated a pellicle forms which he called Geine. The carbonaceous substance, insoluble in water, he called carbonaceous humus, (*terreau Charbonneux.*)

Subsequently he re-analyzed the same water, and discovered that these very substances were crenic and apocrenic acids, combined in part with the bases soda and ammonia, while the ochreous deposit was composed of

Crenated per-oxide of iron,	90.54
Carbonate of lime,	3.54
Phosphate of alumina,	0.38
Silica,	5.54
	100.00

The water of Porla Spring also holds in solution a small quantity of silica.

If any chemist will read the two analyses of this water, and his detailed description of Geine, Apothem, Extrait de Terreau, and Terreau Charbonneux, and then compare the extractive matters which are dissolved from our soils with them, I doubt not he will be satisfied that Geine is nothing more than a mixture of crenic and apocrenic acid occasionally combined with bases.

These acids are common in our ordinary spring waters, and traces of them were detected by Professor Shepard in the waters of the Sulphur Springs of Virginia, several years since. They were also detected in the waters of Spot Pond, by Mr. Hayes and myself, in our analyses of the water.

Crenic and apocrenic acids are precipitable completely from their neutral solutions, by means of sub-acetate of lead, but they are separated from each other most conveniently by means of the salts of copper, as described by Berzelius.

" Crenic acid when pure is of a yellow color, and is quite transparent. It has no tendency to crystallize. It has no smell. Its taste is sharp; at first acid and afterwards astringent. When in solution, the astringent taste only can be observed. When a solution of this acid is exposed to the air, it assumes a brown color, and apocrenic acid is formed.

" In water and alcohol it is excessively soluble. Its salts resemble extracts, and are insoluble in absolute alcohol, but are soluble in a mixture of water and alcohol. When these salts are exposed to the air, they become rapidly brown, and apocrenates are formed, which are easily separated by means of gelatinous alumina.

Crenate of lime consists of

Crenic acid,	20.73
Lime,	5.37
	26.10

Crenate of lead contains crenic acid,	28.02
Ox. lead,	29.80
	57.82

(See Thomson's Organic Chemistry of Vegetables, page 150, 1838.)

Apocrenic acid derives its name from the same Greek root, the affix signifying that it was obtained from the crenic.

This acid exists in the ochre of Porla Well, and was dissolved out from it by boiling the ochre with a solution of potash in water. It is separated from the filtered alkaline solution by acidulating it with acetic acid, and precipitating the apocrenic acid with a solution of acetate of copper. The apocrenate of copper being collected on a filter, was washed, and then while moist was mixed with a little water, and the copper was thrown down by a current of sulphuretted hydrogen gas, and the solution of apocrenic acid separated by means of the filter. The acid being evaporated to dryness, is a brown extract, possessing a purely astringent taste. It is but slightly soluble in water, but dissolves readily in a solution of crenic acid.

It is more soluble in alcohol than in water, though the alcohol does not act upon it immediately. It is precipitable from its concentrated solution by muriate of ammonia, but is soluble again if large quantities of water are added.

Berzelius suggested that many bog iron ores would be found to contain apocrenic acid, and I have found it in many of the bog iron ores of Maine, and Rhode-Island. It also exists in the ochre of the Cranston spring, and probably in all the bog iron ores, and may be one of the causes of the easy reduction of such ores to the metallic state.

Analysis of Humus.

The processes which I have employed are the following. If a large quantity of the organic matters are to be separated for minute analysis, we operate on 1000 grains of the dried soil, but generally find 100 grains a sufficient quantity.

Dry the soil slowly and perfectly at a temperature a little above boiling water. Weigh out 100 grains of the dry soil, and place it in a six ounce glass flask. Then pour upon it four ounces of a saturated solution of pure carbonate of ammonia in distilled water. Stop the flask lightly, and place it in the drying closet where the heat is from 140° to 170° F., or the mixture may be gently boiled for an hour, or until the solution is effected. Agitate the flask frequently to expose new surfaces of soil, after the action appears to be complete, pour off the dark brown solution upon double filters that have been carefully counterpoised.

Add four ounces more of a solution of carbonate of ammonia to the soil, and digest it again. Repeat the operation so long as any color is extracted from the soil. Filter the liquid, collect the insoluble matter, wash it until there is no longer any alkaline reaction in the wash water.

Dry the contents and filters in the drying closet slowly, raising the heat gradually, to above that of boiling water. Separate the two filters, weigh one of them against the other. The difference is the weight of the insoluble soil, which, deducted from the original weight of the soil, gives the amount of matter that has been dissolved out, by the solution of carbonate of ammonia. The residual soil may then be burned in a platina crucible, and the loss of weight will be the quantity of insoluble vegetable matter.

To determine the nature of the matter dissolved by the carbonate of ammonia, we may employ the method that was originally invented by Berzelius, for the separation of apocrenic and crenic acids from their solution in potash, or the modified processes given below.

Acidulate the solution by means of acetic acid, then drop in a solution of the acetate of copper. A brown flocculent precipitate will take place, which is apocrenate of copper. Let the whole stand over night in a warm oven, or drying closet, when all the apocrenate of copper will subside ; filter on double equal filters, collect and wash the precipitate with distilled water. Remove it from the filter with a platina spatula as carefully as possible. Dry it on a glass plate and weigh it. Then dry the filters, and weigh one against the other, and add the difference to the weight of apocrenate on the glass plate or capsule. You may then deflagrate the apocrenate of copper with nitre, and dissolve the residue in nitric acid, and precipitate the deut oxide of copper from the boiling solution by means of a boiling solution of pure potash. Collect, dry and ignite the deut oxide, and you will, by the difference of weight between the apocrenate and the deut oxide of copper, know the amount of apocrenic acid that has been destroyed. Or you might have taken the apocrenate from the filter and have mixed it with a little distilled water, and then by passing a current of sulphuretted hydrogen through the mixture, the copper would be separated in the state of a sulphuret. Then filtrate the liquid, and you will have a brown solution which is apocrenic acid. Evaporate it to dryness in a thin glass capsule, under the air pump, over concentrated sulphuric acid, and you will obtain a brown extract, which is the apocrenic acid in its dry state. Counterpoise the capsule with its contents, then wash out and bring the balance to equipoise by adding weights to the clean and dry glass capsule, this is the weight of the apocrenic acid.

Dissolve it in distilled water and test separate portions of it with sub-nitrate of mercury, acetate of lead, and nitrate of silver, with which you will obtain precipitates identical with those described by Berzelius as characteristic of apocrenic acid.

While the above operations are going on, you can separate the crenic acid from the solution, that has been deprived of its apocrenic acid, by the following processes.

Render the solution slightly alkaline by means of a solution of carbonate of ammonia, boil it to discharge all traces of carbonic acid gas, then when the solution is cold, add, drop by drop, a solution of acetate of copper, and you will obtain a greenish white precipitate of crenate of copper. Let the solution stand in a warm closet (at 140° F.) over night, and the crenate will collect at the bottom of the glass. Filtrate through double counterpoised filters, and wash the precipitate with cold distilled water. Separate the crenate of copper from the filter while moist, mix it with a little distilled water, and pass a current of sulphuretted hydrogen through it, until all the copper is separated in the state of a black sulphuret. Let it subside, decant and filter the liquid, which will be of a pale honey yellow color, evaporate it to dryness in a thin glass capsule placed over concentrated sulphuric acid, under the bell of an air pump. A brownish yellow substance will be found adherent to the sides and bottom of the glass, which is crenic acid, with a trace of the apocrenic, counterpoise the glass with its contents, wash out the crenic acid, and replace the clean dry capsule in the balance, add weights until the balance is equipoised, and the weight will be that of the crenic acid. Dissolve and test it according to the directions of Berzelius, and it will be found to possess all the properties of crenic acid. Weigh the dry filters against each other, calculate the proportion of crenic acid in the crenate of copper adherent to the filter, and add it to the weight of the crenic acid separated.

Having once determined the composition of the crenate and apocrenate of copper, you may afterwards dispense with the separation of the acids, for they may be calculated from the weight of their combinations.

A simple method of effecting this, is to deflagrate the crenate with nitre, as I have described in the analysis of the apocrenate of copper.

I made use of that method when I could not obtain any Bohemian glass tubes for the combustion of these combinations with deut-oxide of Copper.

With Liebig's apparatus it is easy to analyze the crenates and apocrenates with the deut-oxide of copper, or by means of chromate of lead, but the process is rather too long to be generally employed in the analysis of soils.

Peat may be analyzed by means of the processes above described, and it will be found to contain a very large proportion of aprocrenic acid, and a small proportion of crenic acid.

These acids are in part combined with the bases alumina, per-oxide of iron, manganese, magnesia, and even with the electro-negative substance silex, which it renders slightly soluble in water. If crenate of ammonia is evaporated to dryness by heat, it changes in part into an acid apocrenate of ammonia, and becomes brown.

Crenate of lime is soluble in water, and is without doubt an active agent in the nourishment of plants. Apocrenate of lime is more difficult of solution, but is slowly taken up, and colors the water yellow. It is sufficiently soluble to supply the rootlets of plants.

All the alkalies, both fixed and volatile, dissolve crenic and apocrenic acids, and when the mixed solution is evaporated, a dark brown extract is obtained, that splits from the capsule in thin leaves of a brilliant lustre.

Ashes, the alkalies, potash and soda, carbonate of ammonia, and even the alkaline earths, render the inert crenates and apocrenates, in the soil, soluble and active, while the acids and alkalies neutralize each other and render the soil more fertile.

Since I discovered the presence of these new acids in soils, I have also examined the bog iron and manganese ores, in which I had several years since discovered the extractive matter, which was then called Ulmine and Geine, and have found them to contain the apocrenic and crenic acids.

Many of the lake waters around Boston contain the crenic acid, either separate or in combination with lime, manganese, or iron. It is found in the water of most of the wells in the city, and I doubt not is universal.

A spring upon Mr. J. Harris's farm, in Cranston, is remarkably like the water of the Porla Well, and contains so large a quantity of crenic acid as to have a decidedly bitter taste. It deposites an abundance of the crenate and apocrenate of iron, in the form of a light yellow ochre, from which the acids are readily separated by means of a boiling solution of potash. The water of this spring brings in clover wherever it runs ; it is yet doubtful whether this is owing to the minute quantity of sulphate of lime that it contains, or to the presence of the crenates of lime and iron.

The above remarks are given for the purpose of stimulating other persons to continue the researches, in order to learn whether the facts are universal, and that the agricultural value of the substances in question may be tested by experience.

Any chemist can foresee some of the consequences that may be deduced from the above data, and that by chemical means we can bring these new combinations to bear upon the art of agriculture. If the per-oxide of iron in a soil is really in combination with crenic and apocrenic acids, then we can understand why the land is improved by means of an application of ashes and lime, which will dissolve the vegetable acids, and render them convertible into food for plants. Carbonate of ammonia, which is known as one of the most powerful stimulants, as it is improperly called, is capable of dissolving these new acids, and will take them from lime, iron, manganese, and magnesia. Hence the value of animal manures, which generate ammonia, will be understood.

MANURES.

All agriculturists acknowledge the importance of a correct knowledge of the nature and properties of manures, and that the art of preparing them in the cheapest and best manner in adequate quantities, is still a grand desideratum.

Chemical science and art are enabled to point out some of the best methods that are within our reach, by ascertaining the composition of the substances, and by showing how they may be converted into the most efficacious manures ; while at the same time, a chemical analysis of the soil will demonstrate the nature and amount of matters that are required for rendering it fertile. Sometimes correctives and amendments are required for the removal of deleterious properties, or for the improvement of the texture of the soil. Generally it is easy to effect both purposes by means of a properly prepared compost.

By a knowledge of agricultural chemistry, the farmer may take advantage of the natural resources of his farm, so as to enrich the soil at a comparatively trifling expense, and while he draws from it his valuable crops, if he is skilful, he may still render the soil every year more fertile. A liberal supply of manures, with attention to a proper rotation of crops, will supercede the necessity of leaving the land fallow for years, as was formerly practiced. Although organic matters in a decomposed state form the basis of all enriching manures, they are often misapplied and extravagantly wasted, owing to a want of chemical knowledge.

A scientific agriculturist should always be careful and not lose the valuable substances that may separate from manures in a gaseous or liquid form. During fermentation various gaseous matters escape that ought to be absorbed by a covering of peat, swamp muck, sods, or loam. Liquid manures are too generally allowed to run to waste, when they could be easily retained and rendered valuable, by absorbing them with dry peat, or any other absorbent vegetable matters. Manures are too generally exposed to the action of rain, which dissolves their most valuable soluble salts, washing them away into the earth. By due attention to these things, the farmer may make a vast saving of valuable materials that will serve to enrich his land.

I shall now present several analyses of organic products that are used for manures, and shall make some remarks on their peculiarities and mode of action.

ANALYSIS OF HORSE DUNG.

Horse dung, when recent, is highly charged with water, and is covered with mucous matter. Its composition will vary, of course, with the food consumed by the horses. Five hundred grains of the recent manure dried at a heat a little above that of boiling water, lost 357 grains, which was water.

The dry mass, weighing 143 grains, was then burned to ashes in a platina bowl, and left 8.5 grains, 4.80 grains of which was soluble in dilute nitric acid, and 3.20 insoluble. The ashes being analyzed, gave

Silex,	=	3.2
Phosphate of lime,		0.4
Carbonate of lime,		1.5
Phos. magnesia and soda,		2.9
		8.0

It consists then of the following ingredients:

Water,	357.0
Vegetable fibre and animal matter,	135.0
Silica,	3.2
Phosphate of lime,	0.4
Carbonate of lime,	1.5
Phos. magnesia and soda,	2.9
	500.0

When this manure undergoes the putrefactive fermentation, it becomes warm, disengages ammoniacal gas and carbonic acid, which combine to form carbonate of ammonia, or the ammonia enters into combination with the vegetable acids that are formed, and the carbonic acid gas escapes. If the mass is kept moist, and allowed to undergo putrefaction, it is in a great measure converted into a brown powder, or pulp, that is an efficaceous manure. Nitre also forms in the mass. It is evident that the calcareous salts will serve to supply phosphate and carbonate of lime to plants. Hence the error when stable manure is used of supposing that we are raising crops without calcareous matter.

Ribbon weed, or narrow leaved kelp is well known in Rhode-Island as a valuable manure; I was therefore desirous of ascertaining its principal valuable components. Its analysis will be found in this report, p. 180.

The vegetable matter of kelp is very gelatinous, and melts down during fermentation into a semi-liquid mass, much heat being disengaged in the process where large heaps of it are fermented. It is well known to be an excellent manure, and is either composted with other matters, or is spread while fresh upon the fields.

The large quantity of water, which enters into the composition of kelp, renders it a heavy article to transport into the interior, and it can be dried by exposure to the sun and air, so as to be much lighter, and its virtues will in no wise be injured by the process, since it will swell again when it is moistened, and will then ferment.

Associated with the kelp and rock weeds there is cast upon the southern extremity of Newport neck a large quantity of carrageen moss, which is a highly valuable manure, its gelatinous substance resembling animal matter in its properties.

Sea coral is also thrown upon the shores of Newport neck, and is mixed in considerable quantities with the sea weeds. Its composition is stated on page 180.

It is considered a very valuable substance for manure, and is used with the sea weeds.

Eel grass I have not analyzed, but it is evident from its appearance that it contains an enormous proportion of water, and has but little solid substance. When it is recent, its surface is covered with a small proportion of a glutinous matter, that readily undergoes putrefaction. It is used both in its green state and in composts. It is regarded as a weak and transient manure, but valuable where it can be obtained in large quantities.

It contains too much water to allow of the expense of transporting it far into the interior, and will be little sought for where peat, or swamp muck can be obtained as a basis for composts.

Rock weeds are highly gelatinous in their nature, and, like ribbon weed, are valuable for manure. They may be spread while fresh upon grass meadows, or mixed with composts.

Fresh fish are used in great quantities in Rhode-Island, as a manure, and are either spread broad cast upon the surface, or are lightly covered with earth, when they are put into the hills of corn. After mowing a crop of grass, it is customary to spread fish on the surface of the meadows, where they are allowed to putrefy. Sometimes the farmers make a compost of fish, with sand or loam, according to the nature of the soil.

On the island of Rhode-Island, where the soils are frequently clayey loams, sand is found to be a good amendment. The shore sand contains an infinity of fine particles of carbonate of lime, derived from broken shells and sea coral, which are washed upon the shore by the surf.

There is no subject upon which I have heard so many contradictory opinions, as that respecting the value of fish manure, some contending that it is one of the most powerfully enriching substances, and quite enduring in the soil ; others, that it is only a transient stimulant, causing the soil to run out, while it favors the acid grasses and cold mosses, indicative of exhaustion and barrenness. It is the general opinion that no beneficial effect is perceptible from fish after the second or third year.

These differences in opinion on a subject so familiar to the farmers, may in part, arise from the modes of cultivation, and to peculiarities in the soil, while something may be due to prejudice.

After making the most diligent inquiries, and recording the opinions of the most intelligent farmers in the State, I find, on examination of the facts that many testify against the use of fresh fish ; but none whom I have consulted, have given an opinion against the use of fish compost. This is commonly made by throwing a large quantity of fish into a shallow pit, or into a heap, and then covering them with rock-weed and sand, or loam. The whole mass is allowed to putrefy, and is then dug over, and more earth is mixed in. This compost is called *fish pye,* and although not a very savory dish, it is found to be a most efficaceous manure, vastly preferable to the recent fish, since the earths and mixed vegetable matters are charged with saline products of the putrefactive fermentation, and serve as manures.

I trust, ere long, the farmers throughout the State will abandon the disgusting and wasteful practice of spreading fresh fish on the soil, and will convert them into composts ; for not only is the atmosphere of a farm rendered offensive and unwholesome by the stench, but the farmer loses the most valuable portions of his manure, in a gaseous state, when he could easily save every particle of it in his compost heap.

I should strenuously advise the employment of fish with peat and swamp muck, where they can be obtained ; one barrel of fish being a sufficient quantity of animal matter to convert a large wagon load of peat into a valuable manure. Let the peat be spread in some convenient place on the farm, and then fish may be mixed with it in layers, lime being spread over the fish to hasten the decomposition. The whole heap will undergo the putrefactive fermentation, and ammoniacal gas and salts will be abundantly produced, and will impregnate every portion of the peat, or swamp muck, so as to render it a most powerful manure. No odor will be perceptible, if the heap is well covered, and the whole mass will be converted into a black pulp, or powder, and may be used like other manures, either broad cast or in the hill. Every farmer ought to spread at least 20 loads of compost manure per acre on his tilled land every year, if he means to improve the soil so as to render it more and more fertile.

Where fish can be obtained and no peat or swamp muck occurs, rock weeds, kelp, straw, rotten wood, weeds, and earth may be substituted.

Peat and swamp muck are composed of vegetable matters that have undergone a partial decomposition beneath the surface of water or in wet lands. Peat is formed chiefly from the decayed roots of sphagneous mosses, ferns, stalks of various swamp plants and dead leaves, the peat moss being its principal component.

Besides the vegetable matters, there is also a small proportion of the earths silex, clay, lime, and magnesia, which are either mixed or are combined with vegetable acids. Small quantities of sulphate of lime, oxide of iron, and manganese, also occur in some varieties.

Swamp muck is composed of the same ingredients as peat, but the vegetable matters are finely divided, are more soluble, and there is generally a larger proportion of the earthy matters. It is formed of the fine particles of humus, washed out from the upland soils, and of the dead and decomposed leaves and roots of swamp plants.

The pulpy matter of both peat and swamp muck consists chiefly of the apocrenic acid, in part combined with the earthy bases, and metallic oxides. The crenic acid is frequently united with lime. Manganese, iron, and magnesia occur in several of the peats that I have analyzed. Phosphoric acid also exists in them, both in its free state, and in combination with lime and magnesia. In some peats I have found traces of oxalic acid and oxalates.

Peat and swamp muck occur in almost every town in the State, and farms are so situated that they may be abundantly supplied with them.

I am confidently of opinion that when the value of these substances is fully known, they will be eagerly sought for, as the basis of compost manures.

They are extensively employed in Europe for this purpose, and are highly esteemed.

Lord Meadowbank, who first called the attention of British agriculturists to this valuable substance, states, "that after long and watchful experience he is satisfied with the powers and duration of this species of compost. In every diversity of soil, it has given returns in nowise inferior to the best barn-yard dung, applied in the same quantity, and that it is equal if not preferable in its effects for the first three years, and decidedly superior afterwards."

"The carcase of a dead horse, which is often suffered to pollute the air by its noxious effluvia, has been happily employed in decomposing 20 tons of peat earth, and transforming it into the most enriching manure." (See Young's Letters of Agricola, letter 25, p. 238.)

In this country experience has also demonstated the value of peat composts.

Elias Phinney, Esq. of Lexington, Ms., and Mr. Haggarston, of Watertown, who are excellent practical farmers, both declare that a composted manure made of three parts of peat and one of stable manure, is equal in value to its bulk of clear stable dung, and is more permanent in its effects. Mr. Phinney has also been remarkably successful in reclaiming peat bogs, and values such land for tillage more than his uplands. (See his letter appended to this report.)

I have seen the various methods of managing peat composts fully carried into effect, in every form described, and am satisfied that when its use is fully understood, and it shall be generally applied in Rhode-Island, that a new and prosperous era will dawn upon the agriculture of the State.

In composting peat, the farmer should be attentive to the principles on which the art is founded, otherwise by deviating he may commit important errors.

It is essential that animal matters of some kind should be mixed with the peat, for the purpose of effecting its decomposition, aud to produce the requisite gases. Lime is employed to decompose the peat, neutralize acids, and to disengage ammoniacal gas from the animal substances.

The peat greedily absorbs every particle of ammonia, and becomes in part soluble in water. The soluble matter produced is principally the apocrenate of ammonia. Crenate of ammonia and crenate of lime are also dissolved.

Where an excess of animal matter and lime are employed, free carbonate of ammonia is formed. If the compost is mixed with earth and allowed to remain for a long time, nitre is produced, the operation taking place more rapidly in the summer months.

Potash, soda, soapers' waste liquors, and ashes, may also be advantageously mixed with peat, and will serve to render it soluble and fertilizing.

Peat may likewise be used to absorb the liquid manures, which ought to be collected for that purpose, in every barn yard, the dry peat absorbing like a sponge. It afterwards undergoes fermentation in consequence of the animal liquids absorbed. It is stated by Mr. John Young, in his letters of Agricola, that *the liquid manures are of the same value as the solid, and "that one ton of the solid dung will make four tons of compost, and four tons more may be made from the urine discharged by the cattle in the same given time."*

Night soil is a very powerful manure, and may be composted with peat to great advantage, provided it is thoroughly limed, in order to effect its decomposition. It is thus deprived of its peculiar odor, and gives off ammonia in great quantities, so as to saturate the peat.

After considering the numerous methods of preparing peat composts, I ought to urge the farmers throughout the state, to begin forthwith to collect and prepare large quantities of this manure for the improvement of their farms, and I have no doubt but the produce of the land will soon be more than doubled. Every farmer who has a bog or swamp, whenever his business will allow him time, and the peat can be dug, ought to obtain large quantities and throw it up on the uplands to drain, by which its weight will be very much diminished, and by atmospheric influences its quality is improved, especially if it is exposed to the action of frost. It may then be transported to the barn yard or hog styes, and there be converted into compost by mixture with animal excrements. Or it may be made into heaps in the corners of the fields, where it is to be used, fish dung or some animal matters being mixed with it. Lime may be put in at the same time with the animal matters, or it may be introduced early in the spring, when the compost is dug over, in case it has remained through the winter.

It is desirable that the farmer should know how much manure he has on hand, that he may make his calculations accordingly. This may be ascertained at any time, provided the compost is piled in heaps of a regular form, so that it may be measured like cord wood.

Composts ought to be covered during the winter by means of a thatching of straw and a few boards, so as to prevent the action of water. When the crust is frozen, the interior of the mass is preserved from loss by rain, but much is lost before the surface freezes. Some farmers have a regular compost house or shed, erected for the safe-keeping of the manures, and the composts have so little odor that they may be kept near the barn or house without any unpleasant effect.

The following table represents the quantity of matter contained in 100 grains of dry peat and swamp muck that is taken up by digestion at a temperature of 180° F., by a saturated solution of carbonate of ammonia :

No. 1.	Swamp muck from Dyer's swamp, near the foot of Miantonomah Hill, Newport,	27 grains.
2.	Swamp muck, Dr. Harris, Greenville,	25
3.	Do. do. T. T. Hazard, W. Greenwich,	20
4.	Do. do. Flat Pond Meadow, Dr. Harris,	19.5
5.	Do. do. Weaver's Hill, W. Greenwich,	12.5
6.	Peat, W. Rhodes, Rivulet farm,	12.0
7.	Do. Nooseneck factories, W. Greenwich,	10.0
8.	Do. Nooseneck Hill, do.	8.5
9.	George Dawley, Nooseneck Hill,	7.0

In the above experiments it is perceived that swamp muck generally yields a larger proportion of soluble matter to the carbonate of ammonia than peat. This, in a measure, is owing to its more completely decomposed state, but after peat is fermented it will yield a much larger proportion of soluble matter than swamp muck.

I mixed 25 grains of dry peat from the Rivulet farm, with an equal weight of caustic lime, and dropped on water until the lime was slaked, then mixed them together by rubbing the mass in a mortar, and left it for 24 hours. On adding a solution of carbonate of ammonia and digesting at 140° F., it was found that 2.64 grains of vegetable matter was taken up.

I also tried the experiment with peat, and one-tenth its weight of lime, and obtained 2.80 grains, or 0.16 more than in the former experiment. This experiment demonstrates the fact, that lime does not render peat insoluble, and that it exerts no unfavorable influence in the compost is evident from the chemical nature of the operations which take place.

The ammoniacal solutions above mentioned, consist of the apocrenate and the crenate, with a small proportion of phosphate of ammonia.

Mr. Henry L. Kendall, of Providence, during the past winter, has been engaged in the preparation of peat compost. The peat being mixed with night soil, did not appear to have undergone a complete decomposition. He dug it over this spring, (May, 1840,) and put in a quantity of lime, which in ten days completed the process, and the whole is now reduced to a black powder, or pulp, having a strong ammoniacal odor. This gentleman is engaged in the business of soap making, and has advantageously employed his waste liquors by sprinkling them on the soil. He will find it advantageous to mix the salt liquors with peat, since the solution contains a considerable proportion of alkaline matter that will render the peat soluble.

The Rivulet farm peat, when boiled with a solution of carbonate of potash, the alkaline solution being poured off, and renewed so long as any color was produced, yielded in 100 grains of the dry peat,

Soluble matter,	37.0	by loss of weight.
Insoluble matter,	63.0	
	100.0	

This process does not represent the present amount of soluble matter in the peat, and is inexact, since it is impossible to wash out the last traces of potash from the fibrous matter.

Chemical analysis of peat from the estate of Elias Phinney, Esq., Lexington, Mass., made for comparison with those of Rhode-Island. It was sent to me in as dry a state as is required when it is used for fuel, but it still contained water in considerable proportions. One hundred grains of the peat dried at 300° F., weighed 74 grains, loss 26 grains, water. The dry peat was burned in a platina crucible, and left 5.0 ashes of a gray color. The vegetable matter by difference, is 69.0. The ashes analyzed, yielded

Silica,	1.0
Alumina, iron, and manganese,	0.6
Phosphate of lime,	3.0
Potash, traces,	
	4.6

100 grains of the dry peat would give 7 grains of ashes, and 93 grains of vegetable matter.

Analysis of peat from Block-Island, dried for fuel. Dried completely at 300° F., 100 grains of the peat lost 25.25 grs. of water.

'The dry peat = 74.75 grs. burned in a platina crucible, left 6.35 grs. white ashes.

Difference = 68.40 vegetable matter

The ashes analyzed, yielded

Silica,	4.55
Alumina and per-oxide of iron,	0.75
Carbonate and phosphate of lime,	1.10
	6.40
Deduct ashes of filter,	.05 grs.
	6.35

100 grains of the dry peat will contain 91.8 of vegetable matter, and 8.2 of ashes.

It is evident that these peats resemble each other very closely, and will of course answer alike for fuel or manure.

Analysis of peat from the Rivulet farm. Specimen, No. 1. One hundred grains of the dried peat, burned, gave 13 grains of white ashes, which are composed of

Silex,	8.0
Alumina, ox. iron, and manganese,	2.2
Carbonate of lime,	2.8
	13.0

It consists of

Vegetable matter,	87.0
Silex,	8.0
Alumina, ox. iron, and manganese,	2.2
Phosphate of lime,	2.8
	100.0

A specimen of peat from the estate of Messrs. Christopher and William Rhodes, in Pawtuxet, yielded as follows :

100 grains of the peat in its dry state consists of

Vegetable matter, ...	88.6
Silex, ...	9.5
Alumina, ox. iron, manganese and phosphate of lime,	1.9
	100.0

Other analyses of peat will be found in the tables appended to this report.

MINERAL MANURES, AMENDMENTS AND CORRECTIVES.

Mineral substances may be regarded as manures when they enter into the regular composition of plants; or as amendments and correctives, when they improve the texture of the soil, stimulate the absorbent powers of plants, or neutralize and render inert noxious substances. They also act by liberating certain nutritious matters which are subsequently absorbed into the circulating vessels of vegetables.

It is not probable that we yet know every mode of action due to mineral manures, and much light may still be shed upon the subject by the researches of chemists, physiologists and botanists. The subject is one of high scientific and practical importance, and ought to be made one of special research. I am convinced, however, that agriculturists generally have but little knowledge upon the subject. There is much on record that has not received due attention from practical farmers, and there is still more that may be discovered by reasoning upon given data, that have not yet been duly considered, but which are explicable on chemical principles. I allude to those evident chemical changes, combinations, and decompositions that take place in manures and soils, by which certain known elements are brought into action and made to subserve the wants of growing plants.

Many substances that are called stimuli act doubtless by direct chemical laws in bringing into action dormant or inert substances. Others remove deleterious matters and leave the soil capable of nourishing certain vegetables.

Among the mineral substances that may be regarded as manures, amendments, and correctives, are the salts of lime and the fixed alkalies.

It is well known to every scientific agriculturist and chemist, who has attended to the subject, that certain salts of lime, potash, and soda, enter into the composition of the juices, and solid substance of plants, and that no soil is highly fertile that does not possess a certain proportion of lime. If we observe the districts on which wheat crops flourish in the greatest luxuriance, and produce the best grain, we shall always find that the soils are charged with a suitable proportion of lime, and are generally derived from the impure or argillaceous varieties of limestone. The argillaceous matter, serving as a retainer of moisture, and manure, acts favorably upon a calcareous soil, that would, if composed of pure crystalline limestone, fail in the above essential qualities. Those who have never made any calculations as to the amount of calcareous matter contained in an acre of soil, will be surprised to learn that the apparently insignificant proportion of one per cent amounts in a soil whose specific gravity is 1.6, to 1 pound in the cubic foot, and 43,560 pounds to the acre, or 21.78 tons, and if we allow the depth of tillage to be only 6 inches, we shall have no less than 10 tons, 890 lbs.; an amount of calcareous matter that would be considered enormous if we were required to introduce it into the soil at one operation.

Some very rich soils contain three or four per cent of calcareous matter, in the states of carbonate, phosphate, sulphate, crenate, and apocrenate of lime. I have found but 2 or 3 per cent of it in some of the most luxuriant soils of the world. The following analysis of the rich alluvium of the Nile in Egypt, a soil celebrated from the remotest antiquity for its luxuriant vegetation, will serve as a good example. The analysis was made in my laboratory, and under my supervision, by my highly esteemed friend, Benjamin Silliman, Jr., who received the soil from one of the missionaries. I shall give the process of analysis as an example of our methods.

The soil consisted of the annual layers deposited by the Nile, during its periodical overflowings. It contained some fine particles of mica, deposited between its layers, but was destitute of any pebbles or sand. It is of a deep brownish yellow color, and splits readily into thin leaves when dry. The soil having been crushed fine, was sifted through a gauze seive, and no sticks or fragments of rocks were found, excepting the fine particles of mica above mentioned. One hundred grains of the soil dried at 300° F., lost 7.05 grains, which was water.

Its vegetable matter was then burned out in the platina crucible, placed in a red hot muffle, and the loss was 6.9 grains, which was vegetable matter. Digested in muriatic acid 23.432 grains was dissolved, and 68.7 consisted of the insoluble silicates. The analysis having been lost by accident, at this stage was renewed, and 100 grains of the soil previously dried at a temperature above that of boiling water, but not sufficient to brown the glazed paper on which the operation was performed, lost on being burned, 6.90 grains of vegetable matter.

The soil was then mixed with four times its weight of carbonate of potash, and was fused at a full red heat in the platina crucible, so as to render the whole soluble in water. The mass was then dissolved out from the crucible by means of boiling water, and was acidulated with muriatic acid, and then evaporated to entire dryness, so as to render the silica insoluble. The whole mass was then rubbed to a fine powder with an agate pestle, and moistened with muriatic acid. Then all the matters soluble in acidulated water were taken up by means of distilled water. The whole was then poured on a double filter, and the silex was collected, washed until pure, dried and ignited; the second filter being burned and counterpoised against it. The silex weighed while warm amounted to 47.39 grains. The solution that had passed the filter was then treated with a little nitric acid, and boiled to per-oxidize the iron. Ammonia being then added in slight excess, the alumina and per-oxide of iron precipitated together and were collected, washed thoroughly for several days with boiling water, until the water came through the filter pure. The alumina and per-oxide of iron were then separated by means of a boiling solution of pure potash, in a silver crucible. When all the alumina was taken up by the potash, and the iron had subsided, it was filtered in a double filter, and the per-oxide of iron being collected, washed, dried, ignited, and weighed, amounted to 11.20 grains. The alumina was separated by neutralizing the alkaline solution, and was then precipitated by means of a solution of carbonate of ammonia. When collected on a filter, washed, dried, ignited, and weighed, it amounted to 32.10 grains.

The solution from which the alumina and iron had been separated, was then treated with a solution of oxalate of ammonia, and the lime was precipitated in the state of an oxalate, and when collected, washed, dried, ignited, and converted into a carbonate, weighed 2.85 grains. The solution remaining being tested for magnesia, gave no trace, but a little manganese was detected by hydro-sulphate of ammonia.

Results of this analysis of the dry soil :

Vegetable matter,	6.90
Silex,	47.39
Alumina,	32.10
Per-oxide of iron,	11.20
Phosphate and crenate of lime,	2.02
Manganese, traces,	
	99.61

The amount of vegetable matter soluble in a solution of carbonate of ammonia is 1.25 grains, and a solution of carbonate of potash takes up 1.8 grains.

The vegetable soluble matters analyzed, were ascertained to be the crenic and apocrenic acids, with a little crenate of lime.

I have analyzed the alluvial soil from the banks of the Mississippi, taken from a sugar plantation 100 miles above New-Orleans, and obtained the following results from 100 grains of the soil, after it had been dried by atmospheric influences in a warm room.

Water of absorption,	3.9
Vegetable matter,	3.6
Per-oxide of iron and alumina,	7.0
Carb., phosphate, and crenate of lime,	2.8
Insoluble silicates,	81.4
Manganese, traces,	
	98.7

In this case, the soil being analyzed by acids, the insoluble silicate of alumina was not decomposed, and it is supposed to be inert.

The following is an analysis of a very rich soil from Batavia, the specimen having been furnished by J. E. Teschmacher, Esq., from the conservatory of plants in Boston. The analysis was made under my direction, by my friend, Mr. Henry Sumner, of Boston.

100 grains of the soil analyzed :

Water of absorption,	= 7.8
Vegetable matter,	24.9
Per-oxide of iron,	7.9
Alumina,	14.8
Phosphate and crenate of lime,	2.0
Magnesia,	0.3
Insoluble silicates,	43.0
	100.7
Overruns, the alumina not being sufficiently washed,	.7
	100.0

The foregoing analyses of some of the most fertile soils of the world, will serve to instruct us as to the nature and amount of different matters that ought to be introduced into a given soil, in order to render it more fertile. It is not expected that this will be done at a single operation, but it is important that we should know the proper course of improvements, and then we can gradually effect them, according to our means.

When lime is annually added in all our composts, and ground bones are spread upon the soil, we are constantly augmenting its fertility, and in the course of time the farm becomes rich and valuable. In some cases, where calcareous matter may be easily obtained, it may be introduced at once, care being taken to mix it with a sufficiency of composted matters for it to act upon. (See Mr. Dyer's report for an example.)

Lime when used in its caustic state in very large quantities, decomposes rapidly the organic matters in the soil, and if there is not a sufficiency of them for its neutralization, the soil is not materially improved. Carbonate or air slaked lime is generally preferred for a top dressing, when it is required as a corrective, and if there is no acidity in the soil it acts only as one of the regular earthy ingredients, by improving the texture, and furnishing calcareous matter.

It is an important question at present, much discussed,* whether salts of lime are essential to the nourishment of certain cereal grains, and whether the amount of calcareous matter is diminished in a soil by raising upon it successive crops.

It is evident, since all vegetables contain lime in their constitution, that if they are raised on and are removed from the soil after their growth, a certain proportion of the salts of the lime must be abstracted. No one, I presume, will, in modern times, contend that plants create any elementary substance. If they contain lime they must have drawn it from the soil, or from the manures that have been spread upon it.

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* With the highest personal respect for the Agricultural Commissioner of Massachusetts, I must differ from him in opinion on this subject.

One hundred grains of the ashes of the grain of wheat were analyzed by Sir Humphrey Davy, and he obtained 44.5 *per cent of the earthy phosphates*, chiefly *phosphate of lime.*

The ashes of the straw of wheat contains six per cent of the phosphate and one per cent of the carbonate of lime. Clover contains the sulphate of lime, and nearly all the plants known yield a small proportion of calcareous matter. (See Davy's Agricultural Chemistry, pp. 111 to 113.) Although Davy puts down the carbonate of lime as an ingredient in plants, I am disposed to believe that it never exists in that state in the living vegetable, but that certain vegetable acids hold the lime in combination, and when they are destroyed by combustion, the lime is converted into a carbonate.

SALINE MANURES, OR STIMULANTS.

Many organic matters, by decomposition, resolve themselves into salts. Animal matter produces carbonate of ammonia, and gives out ammoniacal gas in large quantites, if it is mixed with lime. Several vegetable acids, when produced by fermentation of organic matter, combine with alkaline, or earthy bases, and form salts. I have already considered some of these combinations, and shall therefore now confine myself to certain salts that have been carefully tried by Mons. Lecoq, of Clermont Ferrand, in France.

He has experimented on the action of the sulphates, muriates, acetates, and carbonates, of various bases, both in solution and in powder, and has stated his results in his prize essay, which was published in 1832.

Copperas, or sulphate of iron, he found to be opposed to vegetation, and a concentrated solution of it destroyed most of the tender plants exposed to its action, and caused them shortly afterwards to fall into a black powder, like peat. It is described as a useful substance to exterminate certain weeds, but on our soils it would require a subsequent top-dressing of lime to destroy its corrosive action. If this was effected, the soil would become more fertile ; but the process is too expensive to employ on a large scale. Sea salt was found to act in a manner similar to gypsum, and may replace it, 300 pounds of salt being equal to 5000 pounds of gypsum.

" 1. Salts, so far as possible, should be used in powder.

2. If used in solution, they must be diluted with a large quantity of water.

3. Saline manures may be advantageously used on all soils.

4. They answer best on light and dry soils.

5. They produce good effects on wet meadows, but must be used in large quantities.

6. It is preferable to spread salts at two epochs, in order to increase their action.

7. Some soils, especially those where mineral springs exist, and those around volcanos, are already charged with a sufficiency of saline matter.

8. In too large quantities, saline matters injure vegetation. In too small quantities, they have no action.

9. The proportions that give the best results, are from 150 to 300 lbs. to the acre.

10. One hundred and fifty pounds to the acre is the best proportion for grazing lands and meadows.

11. These proportions must be varied with the nature of the soil ; and 150 to 250 lbs. per acre, is generally the best

quantity for light soil, but may be increased to 300 lbs. on mowing lands, and even to 600 lbs. on wet meadows, where we may use double this amount without injury to vegetation.

12. These are the proportions for sea salt and muriate of lime; they should vary with the other salts.

13. Fishery salt is preferred, as it is cheaper.

14. Sulphate of soda may be used in quantities from 300 to 600 lbs. per acre.

15. Acetate of lime exercises but little action on plants in quantities below 300 lbs. to the acre, and above this amount is injurious.

16. Ammoniacal salts exert a very marked action on vegetation, and may be employed in the quantities of 150 lbs. of the sulphate, or 100 lbs. of the carbonate, per acre.

17. Sea salt, in certain cases, may replace gypsum in artificial meadows; 150 lbs. of salt being equal to 5000 of gypsum.

18. Nitrate of potash increases considerably the crop, when used in quantities of 150 to 200 lbs. per acre.

19. The best time for spreading the salts is when the young plants begin to put forth their leaves. At the epoch of germination they are more injurious than useful.

20. Salts do not favor the production of seed, unless associated with organic manures.

21. They retard the maturity of plants, and give more development to the foliage, thus opposing evaporation of the liquids which they contain.

22. Burning the soil may be regarded as belonging to the class of saline manures, since salts are formed with the organic matters that the soil contains, and exert a very marked influence on vegetation."

The above are the conclusions of M. Lecoq. I have translated and abridged them from his prize essay on saline manures, which was published in Clermont Ferrand, in

Central France, in 1832, and contains the results of his scientific researches in the botanic garden of Clermont. I am acquainted with the author, and have entire confidence in his accuracy as an experimenter.

I present these results that the farmer may know what has been done respecting saline manures, and hope that the experiments may be repeated here with our cheap saline matters. Soaper's waste contains several of the above named salts, and is known to be a valuable manure, especially on grass lands.

USE OF LIME IN AGRICULTURE.

Long anterior to the christian era lime was successfully employed in agriculture as a fertilizer. Pliny states that the ancient Ædui and Pictones, the inhabitants of two provinces of ancient Gaul, employed it advantageously on their soils.*

The experience of all ages has demonstrated its importance and value as a manure, amendment and corrective. Its use in Scotland has been the means of rescuing a large portion of that country from sterility,† and it has been justly declared to be one of the greatest blessings that their agriculture has received. It has been most highly approved in England, France, Switzerland,‡ Germany, and by many of the most intelligent practical farmers in the United States.

If there is any one principle settled in agriculture, it is that some convertible salt of lime is essential to the fertility of soils, and that certain crops cannot be raised upon a soil destitute of lime. When we consider the most favored grain regions of the earth, it cannot fail to be remarked, that the soils are invariably charged with a notable proportion of lime. On the other hand we note that where the soil is deficient in this respect, such crops are invariably meagre, blighted, and unprofitable. A soil destitute of lime may produce straw, but it never can yield grain. Wheat ashes invariably contain both the phosphate and carbonate of lime, the former salt being most abundant in the grain, and constituting one of its essential ingredients. Indian corn contains the phosphate of lime, its ashes yielding no less than 36 per cent. (See Davy's Agricultural Chemistry.)

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* Ædui et Pictones calce uberrimos fecere agros.

† See Young's Letters of Agricola.

‡ Decandoll's Physiology, vol. iii., and Puvis on Lime.

By consulting the works on agricultural chemistry, the farmer will learn that clover contains a considerable proportion of sulphate of lime or gypsum. Hence it is found that a top dressing of plaster of Paris favors the growth of that valuable grass, and when the soil naturally contains sulphate of iron as it frequently does, lime, by decomposing it and forming gypsum, removes a noxious ingredient, and substitutes one friendly to this and other sweet grasses. Lime being brought in contact with insoluble silicate of potash, by degrees effects its decomposition. Hence its value in decomposing ashes so as to set free the potash. Is it not also highly probable, that where the soil contains finely divided particles of undecomposed felspar, that the presence of lime aids the elimination of the alkali ? It acts partly in this manner upon the green sand of New-Jersey, and renders the soil more fertile.

Lime has been frequently misapplied, and its action is too generally misunderstood. It is by no means a necessary conclusion that, because two or three per cent of it is found to be advantageous, a soil would be fertile if composed entirely of it. Nor is the proportion of two or three, or five per cent, by any means an insignificant quantity ; for five per cent, in a soil weighing 80 pounds to the cubic foot, would amount to more than 43 tons of lime to the acre, within six inches of the surface, the usual depth of tillage.

A comparatively small proportion of lime spread on the surface of the soil charged with vegetable matter, is found to act efficiently, since it enters into combination with the acids produced by their decay, and becomes a soluble and available manure. Even the small quantity of 10 or 12 bushels to the acre, according to Puvis, is found to be a very valuable improvement.

There is one method of introducing lime, that never fails to prove serviceable, and that is, to mix it in our compost manures. In the compost it acts as a powerful decomposing re-agent, and renders the formerly inert matters soluble and powerfully active.

After the vegetable manures have been exhausted from a soil, it cannot be expected that lime will prove serviceable. It must have something to act upon before its useful properties can be developed.

WOOD ASHES.

The ashes obtained from the combustion of wood contain silex, phosphate and carbonate of lime, magnesia, oxides of iron and manganese, and variable proportions of potash. Most of the alkaline matter is in the state of a carbonate, while a smaller proportion of it is combined with the silex.

Leached ashes are always highly charged with carbonate of lime, quicklime being used to render the lye caustic during lixiviation.

Besides these mineral substances, ordinary wood ashes contain vegetable matter that has not been burnt, but exists in the state of charcoal.

Ashes act powerfully on light, dry, and acid soils, improving their hygrometric qualities, and by rendering the insoluble vegetable matters soluble, or by correcting acidities, they highly favor the growth of plants. Ashing, without the application of vegetable matter, exhausts a soil, but nevertheless it may be made the means of enriching it ; since, when a barren soil has its constitution so modified, it is capable of bearing green crops, that may be turned in, so as to augment its fertility. Green crops draw the largest proportion of their substance from the cabonic acid of the atmosphere and from water ; hence their substance being added to the soil, it is of course enriched thereby.

Barilla ashes contain more than half their weight of carbonate of lime, and most of the ashes purchased at soap-works are mixed with it. The lime serves in a manure to supply the place of the alkali that has been removed by lixiviation.

It is well known that leached ashes are highly valuable as an amendment and manure, and when spread upon the light soils or pine barrens, it corrects the acidity of the soil, augments its retentive properties, and renders the soil fertile.

I refer with great pleasure to the well managed farms of Mr. Adam Anthony, and Mr. Henry L. Kendall, of Providence, as illustrating the fertilizing effects produced by ashing the soil.

On analyzing a soil that had been liberally treated with ashes, without any organic manure, I found that a considerable proportion of the vegetable matter had been removed by the crops that had been taken off, but a still larger proportion had been rendered soluble, and the soil before barren was rendered fertile, A green crop being turned in, would restore more vegetable matter than had been lost.

Nitrate of potash or salt petre, is, in many cases, found to be a most active saline manure. It is the constant product of long continued composting of manures with lime ; and the soil beneath stables and dwelling-houses is highly charged with it. Nitre enters into composition of the juices of many plants. I have seen beautiful crystals of it obtained by evaporating the expressed juice of pumpkin-vines; and it probably exists in the juices of many plants of that natural order.

Several good agriculturists of Massachusetts have employed nitre as a manure, with signal advantage. It is, however, an expensive substance, and, like the ammoniacal salts, can only be profitably used on a large scale by indirectly forming it in composts or in the soil.

Potash is a powerful solvent of humus, and is a very valuable material when it can be properly applied. Spread in substance it would destroy the crop. Insolution it would soon be removed by infiltration, since it would be washed out of the top soil by the action of rain, carrying with it vegetable manures, which it dissolves, so that they would be lost, and the soil would be impoverished. Governor Arnold found that a solution of potash did not improve a poor soil. When mixed with peat compost, potash is truly a valuable reagent, since it renders the acid matters neutral and soluble.

It is so powerful that it must be mixed with a very large proportion of the vegetable matter so as to be entirely neutralized. We may safely add 150 pounds of it in solution to a cord of peat compost; but even a much smaller quantity will be found serviceable. When too much potash is introduced, it has been found to act too powerfully, and caused the foliage to become rank, so that frost came before the crop was ripe. On grass lands it would be advantageous to increase the foliage, and potash prepared as described above may be usefully employed.

Soda acts on composts in a similar manner, and since it is now much cheaper than potash, it may be used to advantage in agriculture. The waste salt liquors of the soap works, yield, when evaporated to dryness, according to the statement of my friend, Mr. A. A. Hayes, about five per cent of this alkali in the state of a carbonate. The liquor also contains organic matters, and it has been advantageously employed as a manure by Mr. Kendall, of Providence.

TURNING IN GREEN CROPS.

When other means are not at hand, the farmer may charge his soil with vegetable matter, by turning in a green crop. This may either be done by sowing a crop expressly for the purpose, and turning it in when it is sufficiently advanced ; this being effected always before the formation of the seed. Or the farmer may make the crop a part of his rotation system, and turn it in after once or twice mowing the grass. Thus when wheat and clover seed are sown together, we may take the wheat crop, and let the clover grow and then cut it once. The next spring, about the middle of May, generally, the clover crop being turned in and rolled down, a crop of potatoes, oats, corn, or beans, may be taken from the land without disturbing the sod, which should remain until thoroughly rotted. It is always advantageous however to spread fermented manure on the surface where these crops are planted, so as to have something for the present crop to draw upon, without exhausting the soil. The surface may be best tilled with the cultivator and harrow, so as not to disturb the sod.

In this way many of the comparatively barren, sandy regions of the State, may be reclaimed and rendered fertile. Vegetable matter is a powerful retainer of moisture, and its presence in large quantities prevents drought.

In order to make a green crop grow upon pine barrens, the surface, after ploughing and harrowing, ought to be covered with a good top dressing of ashes, say from 100 to to 150 bushels to the acre. Seed down heavily with clover and herdsgrass and you will rarely fail to obtain a good crop, which may be turned in.

Mr. Phinney states that in the middle of May he collected and weighed the plants in a cubic foot of green sword, and found, on calculation, that the amount was no less than 13 tons of vegetable matter, to the acre. This being turned in, serves to enrich the soil.

He strongly urges the propriety of turning in the green crop in the spring, and observes that the crop thus turned over, serves to prevent the worms from destroying the young crop that is planted over the sod. Whereas, if the crop is turned over in the autumn, a host of worms are supported through the winter, and are ready to destroy the crop planted in the spring. This certainly accords with the facts observed in Rhode-Island.

It is recommended, in turning in a green crop, to plough deeply, at least six inches, and if possible, eight. This affords a new soil and gives a good opportunity for the cultivation of the rolled surface.

The general introduction of the roller and cultivator is highly desirable in Rhode-Island. Many of the best farmers in the state are already familiar with these valuable implements, while there are extensive districts where they are almost unknown.

The best form for a roller is that of a cylinder divided into two parts, and it should be from two and a half to three feet in diameter. It may be five feet long, and should be made of hard Norway pine, or oak plank, and may be loaded at pleasure. The advantage of having the cylinder in two parts, consists in the facility of turning it in the field. A good roller is almost as indispensable on a neat farm, as a harrow ; and when a farmer becomes accustomed to its use, he will value it most highly.

It is vastly better to turn over a green crop, and roll it down, than to cross-plough it and pulverize the sod by the harrow, as is now too generally practised. In the cultivation of peat bogs the roller is indispensable ; for the turf must be turned over and rolled down, before the coarse wild grasses and ferns can be exterminated. (See Mr. Phinney's letter appended to this report.)

Analysis of peat from the estate of J. P. Cushing, Esq., of Watertown, Mass.

One hundred grains of the thoroughly dried peat being burned in a platina crucible, at a full red heat, in the muffle, yielded 4.5 grains of ashes, which does not effervesce with acids, hence does not contain any carbonate. The composition of the ashes is

Silex,	1.3
Alumina, ox. iron, and manganese,	1.5
Phosphate of lime,	1.7
	4.5

The vegetable matter in this peat amounts to 95.5 per cent, and consists of vegetable fibre and of the apocrenic and crenic acids, in part combined with the bases obtained from its ashes. When peat is first taken from the bog it is highly charged with water. After being drained completely, I still found that this peat retained no less than 65.5 per cent of water.

By repeated digestions with a boiling dilute solution of carbonate of potash, 81.6 per cent of this peat is dissolved, and forms a deep brown solution, resembling in appearance a very strong decoction of coffee. Muriatic acid throws down an abundant brown precipitate from this solution. Acetate of lead added to the solution, neutralized by acetic acid, throws down all the substances dissolved, and leaves the supernatant liquor colorless.

Analyses of soils on which peat compost has been successfully used as a manure.

Soils from the estate of Elias Phinney, Esq., of Lexington.

No. 1. Natural soil from a spot just cleared of whortleberry bushes and scrub oaks.

Mechanical separation of the particles.

No. 1.	Pebbles of granite and trap rock,	40
2.	Sand,	140
3.	Fine loam,	820
		1000

Soil dried before analysis, then 100 grains was analyzed, and the following results obtained :

Vegetable matter,	8.9
Insoluble silicates,	82.2
Per oxide of iron,	3.2
Alumina,	4.2
Phosphate of lime,	1.0
	99.5
	5 loss.
	100.0

No. 2. From the orchard.

Mechanical separation of the particles.

No. 1.	Granite pebbles and greenstone trap,	100
2.	Sand,	102
3.	Fine loam,	798
		1000

Chemical analysis of 100 grains of the fine loam dried at 300°.

Vegetable matter,	9.0
Insoluble silicates,	81.3

Per-oxide of iron,	2.8
Alumina,	4.1
Phosphate of lime,	1.0
	98.2
	1.8 loss.

No. 3. Soil from a field near the barn. It has been cultivated for more than 100 years, and is still in good condition.

Mechanical separation of the particles.

No. 1.	Granite pebbles and fibres,	136
2.	Sand,	114
3.	Fine loam,	750
		1000

100 grains of the dry soil analyzed, gave,

Vegetable matter,	8.9
Insoluble silicates,	81.2
Per-oxide of iron,	4.3
Alumina,	4.0
Phosphate of lime,	1.0
	99.4

100 grains of each of these soils being digested in a saturated solution of carbonate of ammonia, at a boiling temperature, yielded

No. 1. Soluble vegetable matter, consisting of the apocrenic and crenic acids, =	1.9 grs.
No. 2.	1.85 grs.
No. 3.	2.80 grs.

Hence it is perceived that the soil No. 3, has been improved by the process of cultivation, the amount of soluble humus having been augmented, while the mineral components are also in good proportions.

Lime is used in the peat compost, that is spread upon the soils of this farm, and with uniform success. Excellent crops of almost every kind of produce are raised. Wheat crops average about 20 bushels to the acre. Corn, 75 to 80.

Analysis of soils from the estate of J. P. Cushing, Esq., of Watertown, Mass.

This farm is cultivated skilfully by Mr. Haggarston. He uses limed peat compost very freely as a manure, and with uniform success.

	Remains on 1st sieve.	2d sieve.	Fine loam.	
Soil marked No. 1,	58	58	884=1000	grs.
" " " 2,	30	50	920	"
" " " 3,	52	86	862	"
" " " A,	172	100	728	"
" " " B,	109	102	789	"
" " " C,	89	104	807	"

The geological origin of the above soils was ascertained from the nature of the minerals contained, to have been from the decomposition of granite, sienite, and greenstone trap rocks.

	Marked No. 1.	No. 2.	No. 3.
Insoluble silicates,	77.00	76.00	77.20
Alumina,	4.20	3.80	2.50
Per-ox. iron and manganese,	4.00	3.00	3.80
Phos. and crenate of lime,	0.50	0.30	0.85
Magnesia,		0.20	0.50
Soluble vegetable matter,	3.10	2.65	2.60
Insoluble vegetable matter,	6.30	8.65	8.50
Water,	4.60	5.38	3.90
Loss,	.30	.02	.15
	100.00	100.00	100.00
Specific gravity,	1.277	1.195	1.255
Cubic foot weighs	79.189 lbs.	73.438	79.688

Soil marked	A.	B.	C.
Vegetable matter,	8.00	10.00	9.60
Insoluble silicates,	81.00	78.50	81.80
Alumina,	3.40	4.70	4.80
Per-ox. iron & man.	6.10	3.00	4.00
Phos. & crc. lime,	0.55	0.80	0.70
Magnesia,	0.44	2.40	0.40
Loss,	.51	.60	
	100.00	100.00	101.30
			1.30 gain, moisture.
			100.00

Analysis of soil from Zula country, Africa, furnished to me by B. Silliman, Jr., who obtained it from one of the Missionaries.

Analyzed under my direction, by Moses B. Williams. One hundred grains analyzed.

Water,	5.00
Vegetable matter,	10.50
Insoluble silicates,	78.20
Per-oxide of iron,	3.40
Lime,	0.20
Alumina,	2.70
	100.00

This soil resembles our lowland swamp soils, but it is said to be very fertile. This may be owing to the climate of the country, for there is nothing remarkable in the composition of the soil.

Chemical analaysis of the peculiar red soil of Cuba, W. I. Crop sugar canes. The specimen was obtained by J. B. Phinney, from the cane plantations of the Perez place. The soil is of a brick red color, is light, but tough when dry.

100 grains of the soil analyzed by Mr. Ebenezer Baker, in my laboratory, and under my direction, yielded

Pure silex,	54.6
Per-ox. iron, alumina, and manganese,	24.8
Magnesia,	2.0
Lime,	1.2
Vegetable matter,	13.4
Water,	4.0
	100.0

Four per cent of the vegetable matter in this soil consists of the crenic and apocrenic acids, separable by carbonate of ammonia.

Soil from the "black land," Roble, Cuba. Crop, sugar canes. One hundred grains analyzed :

Pure silex,	52.4
Per-oxide of iron,	17.0
Alumina,	8.0
Lime,	2.0
Magnesia.	1.0
Vegetable matter,	12.8
Water	8.0
	101.2
	1.2 loss.
	100.0

ANALYSIS OF ATHRACITE FROM RHODE-ISLAND.

I obtained through the politeness of Mr. Veazie, of Providence, ten specimens of the Cumberland coal, from a lot which he purchased of the mining company. The specimens were selected with care as a fair average, and the best specimen was analyzed ; after which a mixture of equal weights from each specimen was taken, and the whole reduced to powder and sifted. Then 200 grains of the mixture were taken for analysis, and burned in the muffle, in a platina bowl, and the ashes, after complete combustion of the coal, were weighed and subsequently analyzed.

The result of the analysis of the average is as follows, the proportions being reduced to per centage.

Water,	7.80
Carbon,	39.70
Silex,	38.00
Alumina,	4.20
Per-oxide of iron and manganese,	9.00
Lime,	1.23
	99.93
Loss,	7
	100.00

The best specimen yielded

Water,	7.6
Carbon,	77.0
Ashes,	15.4
	100.0

The ashes consist of

Silex,	8.0
Alumina and oxide of iron,	7.0
Lime, traces.	
	15.0

The coal found in Providence, in excavating near the Court-House, was analyzed, and the following results obtained. One hundred grains of the dry coal analyzed yielded

Carbon,	72
Ashes,	28
	100

Portsmouth, Rhode-Island, coal from the old mines analyzed. The best specimen yielded

Water,	7.0
Carbon,	87.5
Ashes,	5.5
	100.0

A poorer specimen yielded

Water,	10
Carbon,	74
Ashes,	16
	100

The ashes consisted of

Silica,	7.4
Per-oxide of iron, alumina and manganese,	8.0
Lime, traces.	
	15.4

Coal from Case's mine, received from Judge Child, of Portsmouth, consists in 100 grains of the dry coal, of

Carbon,	97.0
Ashes,	3.0
	100.0

A specimen of the Kilkenny coal, of Ireland, furnished me by Judge Child, was analyzed, and the following results were obtained from 100 grains of the coal.

Water,	12.0
Carbon,	79.6
Grey ashes,	8.4
	100.0

The ashes analyzed yielded

Silex,	6.0
Alumina,	1.2
Per-oxide of iron,	1.0
Lime,	0.2
	8.4

SOILS OF RHODE-ISLAND.

Number.	LOCATION.	REMARKS.	Water.	Vegetable Matter.	Soluble Mineral Matter.	Insoluble Silicious Matter.	Oxide of Iron.	Alumina.	Iron and alumia, not separated.	Salts of Lime.	Magnesia.	Mechanical separation		
												1st Sieve.	2d Sieve.	Fine powder
1	Barrington, A. Bicknell,	Crop last year, potatoes.	3.	9.2	7.4	82.0			6.	1.4				
2	do. Dr. J. Mauran,	Subsoil.	3.4	1.1	3.65	90.2			3.55	0.5	0.5	57	100	842
3	do. do.	Crop last year, potatoes, without manure.	1.4	3.9	4.1	89.8			3.7	0.4		18	200	782
4	do. do.	Crop, corn last year.	1.6	6.4	6.6	85.1			5.9	0.7		97	150	753
5	do. do.	Soil from garden.	1.9	5.6	6.8	85.3			4.9	1.9		63	15	922
6	do. Christopher Smith,	Corn. Soil said to be cold and liable to moss.	3.	7.	3.15	86.1			2.4	0.3	0.45	126	247	627
7	Block-Island, Jeremiah Clark,	Crop, corn, soil light and sandy.	2.7	6.1	4.25	85.8			3.95	0.3		105	95	800
8	do. W. P. Sands,	Crop, grass, one ton to the acre.	2.45	6.35	4.6	85.8			4.6	t		78	158	764
9	do. N. G. Sands,	Corn.	4.3	3.65	4.5	85.55			3.	1.5		100	147	753
10	Bristol, J. D'W. Perry,	Papoosesquaws Neck.	2.5	6.1	5.8	85.6			5.3	0.2	0.3	181	114	705
11	do. Mr. Gifford,	No. 1.	1.6	5.4	8.8	86.6			8.5	0.3		35	87	878
12	do. do.	No. 2.	2.	7.2	8.3	82.0			7.6	0.5	0.2	43	95	862
13	do. do.	No. 3.	1.8	9.5	8.6	78.9			7.1	1.5		35	39	936
14	do. Mr. Bullock,	Orchard.	2.9	8.5	7.5	80.6	4.8	1.8		0.9		81	138	781
15	Centreville, Dr. Harris,	Flat Pond meadow. Subsoil.	2.	4.3	4.1	88.3			3.5	0.4	0.2			1000
16	Connanicut Isl'd, N.E.Watson,	20 bushels of corn to the acre.	2.4	4.8	3.55	86.	1.75	3.2		1.	0.8	40	86	874
17	do. D. W. Clark,		1.2	3.4	3.4	91.1			3.35	0.5	t	3	69	928
18	Cranston, Christopher Rhodes,	" Sour high intervale." Sorrel abundant.	3.9	8.0	3.95	84.1			3.3	0.3	0.35			1000
19	do. do.	Corn field. Sorrel abundant.	1.4	3.1	3.25	92.2			2.3	0.5	0.45	42	132	826
20	Centreville, Dr. Harris,	Clay.	2.6	2.6	7.4	85.4			6.9	0.5				1000
21	Johnston, Mr. Pettis,	Luxuriant clover field.	3.3	9.5	8.6	78.8			7.9	0.7		30	33	937
22	Cumberland Hill, F. Brown,	Corn.	2.8	4.5	5.9	86.6			5.4	0.5		70	73	857
23	Cumberland, J. Whipple,	40 bushels corn and 40 bushels barley to the acre.	3.5	6.3	9.6	80.9	4.6	4.6		0.3	0.1	109	138	753
24	Cranston, Gov. Knight,	Waterman's Mills. (A trace of manganese was found.)	3.6	9.2	9.0	77.8	6.3	2.2		0.5		124	140	736
25	Cumberland, Mr. Lees,	Corn and potatoes.	3.7	8.0	10.	77.3			8.4	1.6		218	152	630
26	Glocester Hill, W. Tourtellot,	Granite diluvium.	5.	12.4	6.2	76.0			6.2			26	83	881
27	Glocester, Chepachet,	Sand hill.	1.	1.5	4.	92.5			3.	0.9	0.1			
28	Great Neck, L. Clark,		4.	8.6	4.5	83.4			4.	0.5	t	10	88	902

SOILS OF RHODE-ISLAND.

Number.	LOCATION.	REMARKS.	Water.	Vegetable Matter.	Soluble Mineral Matter.	Insoluble Silicious Matter.	Oxide of Iron.	Alumina.	Iron and alumina, not separated.	Salts of Lime.	Magnesia.	Mechanical separation		
												1st Sieve.	2d Sieve.	Fine powder
29	Hopkinton.	Greyish white sand.	0.8	0.9	2.6	95.1			2.6	t	t	128	172	700
30	Johnston. Mr. Pettis.	From side of road, uncultivated.	2.3	3.6	9.1	84.6	7.2	1.4		0.3	0.2	51	97	952
31	Do. N. Brown.	Oats, manured with lime.	4.	11.3	9.0	75.3			7.8	0.9	0.3	167	135	698
32	Do. do.	Oats, not limed.	2.	7.4	5.7	85.1			4.9	0.8		136	116	748
33	Little Compton. Dr. Palmer.	Corn manured in the hill with barn manure and pond mud.	3.2	10.1	8.9	78.5	4.7	3.2		0.2	0.1	186	135	679
34	Do. Subsoil.	From forest on road to Adamsville, color dark green.	1.5	2.2	5.8	89.			5.5	0.2	0.1	296	140	664
35	Do.	" " of oaks, do. do.	2.4	4.2	8.9	83.6	6.4	2.2		0.3		165	100	735
36	Do. Dr. Palmer.	Sorrel very abundant. Manured with fish.	4.	9.	5.3	83.			5.3	t		104	108	788
37	N. Providence. Widow Olney.	Louisquiset turnpike. Grain field.	2.9	7.7	6.0	83.3			5.8	0.2		50	107	843
38	Do. Louisquiset turnpike.	Chesnut growth. Magnesia and manganese.	2.9	2.5	9.0	84.2			4.2		4.8	60	140	800
39	Mansville. Mr. Man.	Clayey sand.	0.6	1.2	6.6	90.8			5.6	0.3	0.7	15	20	965
40	Newport. Castle hill farm.		4.5	10.	8.8	75.3			7.8	1.0	t	140	80	780
41	Do. N. S. Ruggles.		4.8	10.	6.4	73.9	4.4	7.1		1.3	0.7	230	53	717
42	Do. Capt. Northam-	Four acre lot.	2.7	7.1	7.4	81.2			7.2	0.2		49	66	885
43	Do. do.	Pond lot.	4.5	8.9	3.92	77.4	2.92	5.13			1.	32	37	931
44	Do. Judge Clark.	Wheat.	5.7	10.2	7.7	77.7	3.5	3.3		0.6	0.3	141	223	636
45	N. Kingstown. A. Browning.	Corn.	2.6	7.7	7.6	81.			7.1	0.4	0.1	15	104	881
46	Do. C. Allen.	Dark brown swamp mud.	4.2	10.4	4.6	75.5			3.9	0.4	0.3	10	59	931
47	Do. H. Cole.	Oats.	2.4	4.7	5.3	87.3			5.0	0.3		47	85	978
48	Do. Mr. Allen.	From garden.	3.1	11.6	6.5	77.			6.1	0.4		3	29	968
49	N. Providence. A. Anthony.	No. 1, in natural state; 10 bushels of corn to the acre.	1.7	4.1	4.2	88.2	2.10	2.1			t	14	165	821
50	Do. do.	No. 2, has been ashed; 1½ tons clover or 30 b. corn per a.	1.6	3.45	5.07	88.2	2.	2.07		1.0		44	161	798
51	Do. do.	No. 3, manured with stable manure and ashes; 60 b. corn.	1.5	4.05	3.39	89.1	2.07	1.32		t		38	183	778
52	Do. L. Clark.	Clay.												
53	Portsmouth. Gov. Child.	Wheat; 3 years ago grass; last year fish manure.	2.8	6.2	6.5	83.4			5.2	0.8	0.5	80	155	765
54	Do. do.	Wheat. [nured onion bed.	3.4	10.5	8.1	77.1			7.5	0.6		174	120	706
55	Do. do.	Corn, large; no manure this year; below a highly ma-	3.3	6.2	8.5	80.4			7.1	1.4		144	158	698
56	N. Providence. A. Anthony.	Potatoes.	2.9	5.4	7.4	85.4	3.4	0.7		0.8	2.5	32	152	866
57	Do. do.	Ditto.	3.1	10.8	4,2	81.7			3.3	0.9		15	103	882

Number.	LOCATION.	REMARKS.	Water.	Vegetable Matter.	Soluble Mineral Matter.	Insoluble Silicious Matter.	Oxide of Iron.	Alumina.	Iron and alumina, not separated.	Salts of Lime.	Magnesia.	Mechanical separation		
												1st Sieve.	2d Sieve.	Fine powder
59	Seekonk. Dr. Gardner.	Corn. Barn yard manure, 10 loads to an acre.	1.7	8.1	9.5	80.5	5.1	2.5		1.9		9	55	936
60	Do. do.	Oats.	2.0	6.4	6.2	87.0			5.5	0.7		10	85	905
61	Do. do.	Top soil.	4.8	12.	6.65	76.			6.6	0.05		58	230	712
62	Smithfield.	Forest oaks and chesnuts.	3.7	5.6	10.1	80.0	6.5	3.2		0.4		67	190	843
63	Do.	Soil from decomposed hornblende rock, Harris' lime quar.												
64	Do.	Soil from decomposition of limestone, do. do.												
65	Do. Arnold.	Subsoil. Corn.												
66	South-Kingston. Point Judith.	Clay.												
66½	Smithfield.	Near hard rock.	5.6	13.9	13.8	65.6			12.4	1.2	0.2			
67	Scituate. B. C. Hopkins.	Barley.	2.0	6.7	5.7	86.1	1.9	3.0		0.8		100	114	786
68	Smithfield. T. Smith.	Oak.	1.7	6.8	7.2	83.7			6.5	0.7		56	129	825
69	Do. Mr. Ballou.	Corn ; subsoil.	3.4	7.8	9.1	80.3	6.1	2.3		0.2	0.5	120	108	772
70	Do. Do.	Corn.	4.9	12.1	7.8	76.	4.4	3.0		0.4		135	136	729
71	Do. Mr. Harris.	Barley. (Some manganese.)	3.2	7.1	6.3	81.8			4.8	0.5	1.0	167	159	674
72	Do.	Hornblende soil. Corn.	5.5	3.8	12.8	67.0	8.6	0.3		t	3.9	140	100	760
73	Do. A. Arnold.	Corn. Subsoil.	2.3	6.0	6.7	83.8			5.5	0.2	0.9	26	46	938
74	South-Kingston hill.	Corn.	3.9	10.8	6.0	78.6			5.6	0.4	t	146	106	758
75	Do. South ferry.	Pasture.	2.0	7.6	3.1	86.0			2.8	t	0.3	15	58	927
76	Do. plain.	Good corn.	3.4	9.0	6.5	80.6			6.3	0.2		69	55	876
77	Do. L. Clark.	Decomposed granite.	1.3	2.0	4.9	92.1			3.5	0.8	0.6			
78	Do. J. D. Austin.	Barley.	4.5	12.8	3.3	79.1			3.0	0.3		57	190	753
79	Do. Gov. Arnold.	Potatoes ; not manured.	2.9	11.	5.2	80.6			4.7	0.5		63	94	843
80	Tiverton. Judge Durfee.		2.5	7.9	8.8	79.7			8.1	0.7		250	139	611
81	Do. do.	Oatfield.	3.9	8.75	8.35	76.5			7.6	0.3	0.45	210	96	694
82	Do. do.	Wheat.	4.2	8.2	7.55	78.6			7.3	0.25		204	116	680
83	Warwick Neck.	Capt. Holden.	1.9	7.4	5.2	85.2			5.0	0.2		147	100	753
84	Woonsocket.	Mica slate mixed with vegetable matter.	2.2	4.5	12.	81.3			11.	1.0	t			
85	Do.													
86	Do. Mr. Hotchkiss.													
87	Warwick. Gov. Francis.	Seaweed manure. Corn.	1.2	7.4	4.4	90.4	3.5	0.5		0.4		100	140	760

SOILS OF RHODE-ISLAND.

Number.	LOCATION.	REMARKS.	Water.	Vegetable Matter.	Soluble Mineral Matter.	Insoluble Silicious Matter.	Oxide of Iron.	Alumina.	Iron and alumina, not separated.	Salts of Lime.	Magnesia.	Mechanical separation		
												1st Sieve.	2d Sieve.	3d fine po.
88	Warren Neck, Samuel Mason.	Corn.	4.0	10.	6.45	78.			6.35	0.1	t	78	104	818
89	Warwick, Gov. Francis.	Oak forest. Large pine growth.	3.8	8.6	7.7	79.6	4.7	2.4		0.6		58	208	734
90	Warwick, G. Spencer.	Sand.	0.5	4.3	4.6	90.			4.4	0.2				1000
91	West-Greenwich, Mr. Dawley.	Subsoil.	1.8	3.2	8.41	87.3	2.9	5.5		t			2	998
92	Westerly, Mr. Potter.	40 bushels corn to the acre last year.	2.5	5.4	4.6	86.3			4.3	0.3	t	94	171	735
93	West-Greenwich, Mr. Dawley.		2.5	6.0	5.2	86.0			4.5	0.25	0.45			1000
94	West-Greenwich, J. P. Stone.	Grass, lime manure, with gypsum.	4.8	11.9	5.85	76.0			5.8	0.5		80	146	774
95	Westerly, T. W. & S. Potter.	Alluvial barren.	4.4	13.2	5.7	76.0			5.4	0.3	t	2	35	963
96	Wickford, J. C. Sandford.	Corn, small; hog manure, 8 loads to the acre.	2.1	5.6	7.6	84.4			6.9	0.7		31	147	822
97	do. Judge Pitman.	Soil from orchard.	1.475	4.390	5.850	87.45	2.725	2.625		0.2	0.3	38	183	779
98	do. T. C. Sandford.	Corn, large; manure, peat compost.	2.2	6.1	6.1	85.5			5.5	0.6		23	129	848
99	Woonsocket, N. Aldrich.	Corn.	2.1	6.6	6.	84.2			5.8	0.2		152	64	784
100	Woonsocket.		2.3	3.5	7.1	85.4			7.1			137	82	771
101		Moulding sand, bright yellow.	2.4	3.4	5.7	86.6			5.5	t	0.2	13	90	897
102	South-Kingstown, table land.	Fine yellow soil of granitic origin.												
103	Olneyville.	Tertiary sand, containing vegetable matter.												
104	Bristol Neck, farm of P. Church	Soil from grau-wacke rocks. Pastured.												
105	Warwick-Neck, Capt. Holden's	Soil formed from slate rocks, impregnated with carbon.												
106	Woonsocket, Cumberland.	Soil from decomposition of mica slate.												
107	Cumberland.	White clayey sand, near road.												
108	Olneyville.	Diluvial granitic gravel.												
109	"	Tertiary sand from the high land.												
110	"	Diluvial peat, with vegetable matter.												
111	"	Diluvial ferruginous sand, and vegetable matter.												
112	Bristol, Ferry.	Soil from decomposition of granite.												
113	Hopkinton.	Soil from decomposition of gneiss.												
114	Block Island, Sandy point.	Magnetic iron and beach sand.												
115	Scituate, B. F. Hopkins.	Barley field.												
116	Barrington, A Bickwell.	Soil. Corn last year; 3.4 ton hay to acre, this year.												

PEATS, RHODE-ISLAND.

Number.	LOCATION.	REMARKS.	Water.	Ashes.	Vegetable Matter.	Silica.	Iron and Alumina.	Lime.	Magnesia.	Potash and loss.
1	Cranston, Rivulet farm.			13.	87.	8.	2.2	2.8		
2	Block-Island, west side.		25.25	6.35	63.4	4.5	0.75	1.1		
3	Bristol, —— Bullock's.	Light and porous.		13.9	86.1					
4	Cummerland, J. Whipple.			76.	24.	69.3	3.2	0.5	0.3	
5	Cumberland Hill, Sneech pond.	Light, flaky, and fibrous, color, brown.		2.15	97.85	0.45	0.25	1.30		1.5
6	North-Kingston, Gov. Arnold.	Compact, red brown.		25.6	74.4	21.2	2.4	1.5		0.5
7	Do. W. Carpenter.	Heavy.		65.	35.	57.6	0.5	.55		
8	South-Kingston, J. D. Austin.	Ashes, mostly of silica.		62.5	37.5					
9	Do. Point Judith, near windmill.	Gravelly, rather heavy and fine.		48.4	51.6	41.35	4.20	1.2	0.3	
10	Do. do. do.			10.5	89.5	7.0	1.5	0.6		1.2 Phos. Manganese.
11	Cranston, —— Potter.			7.9	92.1	6.3	0.9	0.7		
12	Pawtuxet, C. & W. Rhodes.			11.4	88.6	9.5	1.9			
13	Wickford, Judge Pitman.		15.9	11.5	72.6	8.9	1.5	1.1	0.2	
14	Woonsocket.		10.	1.8	88.2	0.5	0.3	0.6		0.4
15	Warwick, Mr. Westcott.		13.5	49.	37.5	40.7	5.1	3.2		
16	Warwick, J. F. Arnold.			4.	96.					
17	Wickford, Mr. Sanford.			12.	88.					
18	S. Kingstown, Boston Neck, Room farm.			17.5	82.5	12.	2.1	2.5	0.5	0.4
19	Pawtuxet, Wm. Rhodes.			32.5	67.5					
20	Warwick, Pottawoomett.	R. W. Greene, Esq.		10.5	89.5					

LIMESTONES, RHODE-ISLAND.

No.	LOCALITY.	VARIETY.	Carbonate of Lime.	Insoluble Matter.	Oxide of Iron.	Magnesia.	Lime.	Specific Gravity.
1	Cumberland Hill, F. Brown.	White, greenish, granular.	52.2	6.		40.6	29.4	2.728
2	Do. do.	Greenstone. (8.0 water.)	68.8	23.2	1. al.	6.2	38.7	
3	Johnston, Mr. Brown.	Stone white, yellowish spots, and crystalline.	55.2	46.6		4.2	31.1	
4	Do. Mr. Jenkins.	Stone white, and green crystalline.	97.2	0.8		0.6	54.6	
5	North-Providence.	White compact sub-crystalline.	56.1	11.4		32.50 m & i	31.6	
6	Newport Harbor, Lime Islands	Compact, blue and buff colored.	53.20	7.0	1.9 m.	37.9	29.9	2.824
7	North-Providence, lime quarry.	Stone white, and compact.	68.6	8.6		21.	38.6	
8	Smithfield, Harris rock.	Rhomb spar.	92.8		3.8 m.	3.4	52.2	
9	Shore near Fort Adams.	Yellow buff colored. Compact.	50.9	4.30	2.10 m.	42.7	28.7	2.822
10	Smithfield, Harris quarries.	Soft rock.	92.4	6.	0.4 m.	1.2	52.	
11	Do. Harris rock.	First quality hard rock.	60.4	1.	2.6	36.0	34.	
12	Do. Dexter's quarry.	White, granular, and crumbly.	94.8	1.6			53.4	2.660
13	Do. do.	Compact, white insoluble matter, in acicular crystals.	64.6	2.0	t	32.0	36.4	2.853
14	Do. S. Arnold.	Stone white, coated with talc, and crystalline.	50.6	3.8	t	44.4	28.5	
15	Do. Harris quarry.	1st qual. soft blue stone, with blue and white stripes, do.	92.2	1.0		6.8	51.9	
16	Do. Harris rock.	Crystalline and granular.	95.8	1.4		2.8	58.	2.681
17	Do. do.	Very clear light blue, stratified and crystalline.	87.	12.4			49.	2.715
18	Do. E. Angell.	Stone, white and crystalline.	97.6	1.			54.9	

FARM REPORTS.

Lexington, January 30, 1839.

Dr. Charles T. Jackson,

Dear Sir :—I herewith send you a sample of my peat. I am very desirous of availing myself of the benefit to be derived from a chemical analysis of the same, which you kindly offered to make. A more intimate knowledge of the nature and properties of peat, which can be obtained only by a scientific examination of its constituent parts, would enable farmers more justly to appreciate this valuable species of land. It is from a want of this knowledge, that our extensive tracts of low meadow and swamp lands have hitherto been esteemed of little, or no value. Allow me to say, sir, that I know of no way, in which you could render a more essential service to the public, more especially to farmers, than by enabling them to convert their unproductive and unsightly bogs and morasses into luxuriant fields, and sources of wealth. I consider my peat grounds by far the most valuable part of my farm, more valuable than my wood lots for fuel, and more than double the value of an equal number of acres of my uplands, for the purposes of cultivation.

In addition to these, they furnish an inexhaustable supply of the most essential ingredient for the manure heap.

A statement of the uses, to which I have appropriated peat lands, and my management of them, though very imperfect, may serve to give you a partial conception of their value and uses, and at the same time enable you to see how important it is that the farming community should have more information on this subject.

In the first place they are valuable for fuel. I have for twenty years past resorted to my peat meadows for fuel. These, with the pruning of my fruit trees, and the brush from my uncleared lands, have given me my whole supply. The prunings and brush are bound in bundles, and housed, and with the help of a small bundle of these faggots, and peat, a quick and durable fire is made. It gives a summer-like atmosphere, and lights a room better than a wood fire. The smoke from peat has no irritating effect upon the eyes, and does not in the slightest degree obstruct respiration, like the smoke of wood ; and it has none of that drying, unpleasant effect of a coal fire. The ashes of peat are, to be sure, more abundant, but not more troublesome, and are less injurious to the furniture of a room, than the ashes of coal.

The best peat is found in meadows, which have for many years been destitute of trees, and brush, and well drained, and where the surface has become so dry, and the accumulation of decayed vegetable matter so great, that but little grass or herbage of any description is seen upon the surface. If the meadows are suffered to remain in a wet and miry condition, the wild grasses and coarse herbage will continue to grow, and the peat be of a light and chaffy texture, filled with undecayed fibrous roots. By draining they become hard, and the peat becomes compact and solid, and the cutting out, and carrying off greatly facilitated. A rod square, cut two splittings deep, each splitting of the length of eighteen inches, will give three cords when dried. It may be cut from May to September. If the weather in autumn be very dry, the best time for cutting will be from the middle of August to the middle of September. If cut the latter part of summer, or early in autumn, it dries more gradually, and is not so liable to crack and crumble, as when cut early in summer. The pieces are taken out with an instrument made for the purpose, from two to three inches square; and if of good quality, will shrink about one half in drying. It is considered a day's work for a man, a boy, and a horse, to cut out and spread a rod square. The man cuts it out, and lays it upon a light kind of drag, made for the purpose, and it is drawn off by the horse, and spread by the boy as thick as the pieces can lay singly. After becoming dry enough to handle without breaking, it is made into piles, cob-house fashion, of from twelve to twenty pieces in a pile. It will then require about four weeks of dry weather to render it fit to be housed for use. The top, or turf, is thrown back into the pits, from which the peat is taken; and if well levelled, and the ground drained, it will, after the first year, give a large crop of foul meadow, or other lowland grass. Peat, taken from land which has been many years drained, when dried, is nearly as heavy as oak wood, and bears about the same price in the market.

The value of peat and swamp lands for tillage, is now pretty well known, and acknowledged. Some years since, I occasionally sold my neighbors a few rods of my peat land, yearly, to be cut out for fuel, at three dollars per rod, being at the rate of four hundred and eighty dollars per acre; but finding this sum to be less than its value for cultivation, especially when laid to grass, I have declined making further sales at that price. I have raised upon my reclaimed meadows, seventy-five bushels of corn, five hundred bushels of potatoes, or from four to five tons of the best hay, at a first and second cutting, to the acre, at a less expense of labor and manure, than would be required to produce half this crop upon uplands. To render these lands productive, they should be thorougholy drained, by digging a ditch around the margin of the meadow, so as to cut off the springs, and receive the water that is continually flowing in from the surrounding uplands. If the meadow be wide, a ditch through the centre may be necessary, but this will be of no use without the border ditches. This being thoroughly done, and the surplus water all drawn off, the next step is to exterminate the wild grasses, and herbage of every kind, that grow upon the surface. To effect this, the method heretofore generally, and now by some pursued, is to cover with gravel or sand, top dress with manure, sow the grass seed, and then rake, or bush it over. This, for the first year or two, will give a good crop of hay ; but after this, I have invariably found that the more coarse and hardy kinds of wild grass would work their way through the sand, or gravel, and entirely supplant the cultivated grasses—when the whole must have another covering, or be abandoned as worthless. If to be planted with corn, or any of the root crops, my course has been to turn over the turf or sward with a plough having a wrought iron share or coulter, ground to a sharp edge, in the driest season, say in the month of September, roll down as hard as possible, carry on in the winter a sufficient top dressing of compost, twenty cart-loads to the acre, and in the spring plant with corn, or roots, without disturbing the sod. When the corn or roots are taken off, the surface is made smooth with the cultivator, or hoe and harrow, and late in November, or just before the heavy frosts set in, sow with herd's grass and red-top seed, half a bushel of the former and one bushel of the latter to the acre. The field is then rolled, which completes the process. If the plough does not turn the sods smooth, it will be necessary to follow it with the bog hoe, to level the uneven places. By keeping the sod undisturbed in the cultivation, a more firm and compact surface is formed, upon which oxen or horses may work, generally, without danger of miring. If the land is intended for grass, without the intervention of a hoed crop, the turf is turned over with the plough, as before stated, in August or September, or as early as the surface becomes dry enough to admit the oxen or horses upon it; then follow with the bog hoe, and turn over such parts as the plough has left unturned, make the whole smooth with the hoe, and late in November, spread on a top dressing of compost, not less than twenty cart-loads, made half of loam, and half of stable manure, to the acre; then sow the grass seed, and bush, and roll down. If the ground be miry, so as to render the use of the plough impracticable, the bog hoe must be resorted to, and the whole turned over by hand, and top dressed, and seeded to grass, as above stated. The cost of turning over with the hoe, will be twenty dollars per acre, at the usual price of labor. This mode of culture completely subdues the natural wild grasses, and gives a compact and rich surface of vegetable mould, which will give an abundant crop of the best English hay for four or five years, without the aid of more manure. If the sod is disturbed and attempted to be pulverized in the course of the cultivation, the surface, when laid to grass, will be loose and spongy, an extra top dressing of loam and manure will be required, and after all, the surface will not become so compact, nor the produce by any means so great. Should meadows be found too soft and miry to admit of their being ploughed in the summer, or autumn, and the expense of turning with the hoe should be thought to be too great, I would advise ploughing in the spring, when the frost is out to the depth of three or four inches, carting on the manure, and then sowing or planting at a convenient and proper season. The art of reclaiming these low meadows, consists in taking off all the surplus water by judicious draining, and in thoroughly exterminating the natural herbage and grasses. This being effected, we have our rich bottoms, equally as productive as the deep alluvials of the west, and obtained at a cost and sacrifice infinitely less.

The third particular, in which peat lands may be considered valuable to the farmer, consists in furnishing him with a very important ingredient for his compost. Peat is made up principally of decomposed vegetable substances, with a portion of the lighter particles of vegetable mould, washed in, from the surrounding highlands. But when taken fresh from the pit, it contains certain antisceptic properties, injurious to vegetation, which must be absorbed, or neutralized, by a combination with other substances, in order to render it food for plants. This may in some measure be effected by exposure to the action of the air and frost. Where the surrounding uplands are composed of gravel or sand, the peat or swamp mud may be called silicious, and is less valuable for manure, especially if the adjacent uplands rise abruptly; when composed principally of clay, the peat is aluminous—this is frequently found resting on beds of marl, and is considered much richer, and more valuable for the compost heap.

I have annually, for some years past, used on my farm some hundreds of loads of peat mud, which is either thrown into my hog stye, or mixed with fresh stable dung, or with lime. When mixed with green stable manure, the proportions are two parts of peat mud to one of dung; and I am confident, from repeated experiments, that a load of this compost, well mixed and fermented, will give as great a produce, and a more permanent improvement to the soil, than the same quantity of stable manure. In this opinion, I am not alone. Other accurate and intelligent cultivators, have made similar experiments with similar results.

The vegetable substances of which peat is composed, having been decomposed in stagnant waters, they have not passed through a putrefactive fermentation, and are therefore supposed to retain much of their natural oils, gums and acids. Peats, in this region, are also supposed to contain portions of sulphate of iron, or copperas, oxide of iron, &c. This opinion is formed from noticing the difference between the effect produced by using the peat mud on grounds, when first taken out of the meadow, and that which is produced after fermention, with stable manure, or by mixing it with lime. The ashes of peat have little or no perceptible effects, when used alone, but by mixing them with lime, they become a valuable manure.

That our peat may possess other and different properties, which are in a greater or less degree injurious to plants, is highly probable. These can be detected and remedied only by the aid of science. It is to the agricultural chemist, that the practical farmer must look for a developement of his resources, to remove the obstacles which impede his progress, and to impart that information which will give confidence to action, and a successful issue to labor.

With an earnest desire that you may persevere in your useful labors, I am, dear sir,

With the highest respect,

Your obedient servant,

E. PHINNEY.

No. 1.

Farm Report of B. F. Hopkins, Scituate, 1839.

My farm consists of ploughed land, 7 acres; grazing and pasture, 60 acres; mowing, 38, and wood, 95. Total, 200. Value per acre, $50. Crop, corn; 100 bushels, 33⅓ bushels per acre, valued at $40. Soil, loam, manured with 10 cords stable and compost; cost of cultivation, $15.

Barley, 118½ bushels, 39½ bushels per acre, valued at $40. Soil, loam, manured with 10 cords, cost of cultivation, $5.

Potatoes, 400 bushels, 160 bushels per acre, valued at $40. Soil, loam, manure 4 cords. Cost of cultivation, $10.

Beets, 10 bushels, turnips 6, parsnips 8, pumpkins and squashes, valued at $25.

Hay, 50 tons, 1½ ton per acre; cost for procuring, $3 per acre, valued at $18 per ton.

Stock.

5 horses, valued at	$500	15 swine, valued at	$300
2 oxen.	120	6 young stock,	75
12 cows.	360		

Produce.

Beef,	600 lbs.	Cheese,	600 lbs.
Pork,	3000	Cords wood sold,	220
Butter,	1100		

In estimating the acreable cost of cultivation, manure is not included.

No. 2.

Farm Report of Job Durfee, Tiverton, 1839.

Farm consists of ploughed land, 22 acres; grazing 47, mowing 46, orchard 4, wood 30, peat and unreclaimed swamp 10. Total 159 acres. Value of land per acre, $100. Soil generally stiff loam.

Crops, Indian corn, 400 bushels, 40 bushels per acre, manured with ten large ox loads of fish compost and barn yard manure. Wheat, 14 bushels, 20 bushels to the acre, blasted: land manured with fish in 1838. Barley, 50 bushels to the acre, injured by the fly. Oats, 334 bushels, 56 bushels to the acre; not manured the present year, the crops followed indian corn. Mangel wurtzel, 362 bushels, 1086 bushels to the acre. Turnips, 250 bushels, grown among corn. Hay, 46 tons, one ton to the acre.

Stock.

Horses,	2,	raised	2,	valued at	$140.
Oxen,	6,	do.	4,	do.	300.
Cows,	8,	do.	8,	do.	240.
Sheep,	100,	do.	100,	do.	200.
Swine,	12,	do.	12,	do.	
Young Stock,	12,	do.	12,	do.	130
Poultry,					50

Wood, 12 cords.

Produce.

Beef, butter, cheese, milk and wool not estimated. Wool, 3 pounds to the fleece.

Corn estimated,	$400
Wheat,	20
Oats,	133
Barley,	40
Potatoes,	70
Turnips,	60
Beets,	70
Pumpkins,	15
Hay,	700

1st QUESTION.—What Agricultural experiments have you made? (See below for answer.)

2d. What is the result of your researches or observations concerning the use of *Lime* as an amendment to soils, or as an ingredient in composts?

I have made no experiments with *Lime*.

3d. Have you used *Ashes*, live or spent, or Hard Coal Ashes, as an amendment, and what is the results of your experience?

I have used spent ashes occasionally, to a limited extent, and as far as my observation extends, with favorable results.

4th. Have you made use of *Peat* for manure, alone or in compost, and with what results?

I have used an imperfect peat, or rather swamp mud, with fish and turf. The compost made a manure much quicker, and more active than any other that I have used, but I doubt whether it will carry a crop to maturity so steady as good stable manure. It does best in wet seasons.

5th. What is your opinion respecting the use of a compost made of 4 *cords of peat*, 2 *cords of stable manure, and* 4 *casks of lime*, well mixed, *as a compost manure?* Will you please to try it?

To this compost I would add sand, especially if to be used on a close, heavy soil. I have never tried this compost, but certainly think it highly worthy of a trial.

6th. What are the relative values of Fish and Stable manure?

Fish manure is more active and quicker than stable manure. Fish used alone, exhausts itself in three or four years, unless the crop be consumed on the ground. After being used on corn, it throws up a great crop of grain, (if grain follow,) but the new meadow is too frequently light. Its use should be continued on the new meadow. I cannot speak definitely of their relative values.

7th. Have you used Rock Weed, Ribbon Weed, and Eel Grass for manure, and with what results?

I have used Rock Weed, and Eel Grass, in composts of the barn-yard, &c., but never alone.

8th. Have you tried any experiments respecting the use of Muscle or Marsh Mud, or of ground Oyster Shells, Clam Shells, or ground Bones, as amendments to soils?

I have used broken Clam Shells, the remains of Indian feasts; I think with good effects, but cannot speak definitely. I am beginning the use of Marsh Mud, but am not as yet, able to speak of results.

9th. What means do you use for the prevention of smut in Wheat, and to what results do you arrive?

I have steeped my seed wheat in brine for 7 hours, and then limed it, to no effect. I have steeped it for 16 or 18 hours, and then rolled it in ashes, with apparently some beneficial result, but have found no effectual remedy.

10th. What crops are the most profitable to raise on your farm? Indian Corn, Oats, Barley. (See remarks.)

11th. What is the value of your produce in market?

See the estimates I have put upon the several products.

12th. Do you save the liquid parts of your manure by any vat under your stalls or stables, and have you made any experiments as to the value of such manure—please mention the results?

I must answer this question in the negative.

GENERAL REMARKS.

In my estimate of the quantity of ploughed land, I include that sowed with grain. My estimate of mowing land includes only meadows.

In my estimate of the quantity of Indian corn raised, I include some raised in my orchard; in ascertaining the average to the acre, I take no note of the orchard land, for I am not able to ascertain what portion of it was planted, it having been planted with corn only where open to the sun. In fact, for this season I doubt not that my estimate of this crop is large; but to estimate it at less, would deceive. The average, even as it now stands in the return, is much below the common average. I was greatly disappointed in this crop, the present year. I attribute my disappointment to the violence of two gales in August, particularly to the first, which, though less violent than the second, was most injurious, prostrating my corn, which was of an early kind, when just in the milk. My Dutton corn suffered severely; it was not half a crop. Worms also injured the crop severely. I speak now with reference to that part of the crop raised on a newly turned sward. We took from an acre of old ground, where corn was raised the preceding season, fifty bushels, and one hundred bushels of French turnips, besides pumpkins. This was the last planted, and seemed to have suffered least from the winds. I do not think highly of the Dutton corn ; nor do I think it generally a judicious practice, in our foggy climate, to cut up corn and shock it.

Our wheat was, up to the period of forming the grain, very promising ; it then suddenly shriveled. Was this caused by the honey-dew ? There was not half a crop.

Barley, years past, was our most valuable grain. It is now a very uncertain crop, owing to the ravages of an insect, the egg of which is deposited in the growing stalk.

The oat crop may appear large, compared with my other crops, but we have measured not only the product, but the land, and the return is rather under, than over the true amount. The quantity given is the quantity actually taken up. There could not be less than double the quantity usually sown shelled out before it was stacked, and thus entirely lost. From one lot consisting of about an acre and a quarter we threshed out and measured ninety-six bushels. This was corn land last year, and was then fished at the rate of thirty barrels to the acre in addition to the usual manuring.

No. 3.

WARWICK, April 4, 1840.

DR. C. T. JACKSON,

Dear Sir—Your blank form of a farm report was put into my hands sometime since, but in consequence of my having been employed the last year in other business than attending to my farm, I cannot fill the report with accuracy. I will, however, give you a brief account of my proceedure in farming for about thirty years. In 1808, I commenced farming on the farm I now own, and which was previously owned by my father. I took no pains to make manure, and as was the practice among my neighbors, I milked my cows in the pasture, and let my hogs run in the road. The land was not then very much exhausted, and we could raise from 15 to 30 bushels of corn to the acre, without manure. This I found was wearing out my land ; and in the year 1811, I commenced a new course. I yarded my cattle, carted loam into my cow-yard, shut up my hogs, &c., and the next season I planted a larger field of corn than usual, and put the manure all in the hill, and this greatly increased the crop of stalks, but not much that of corn. I found this would not do, and as I had not manure to spread on a large field in one year, I came to the conclusion to manure a small one ; and I carted on and spread twenty-five loads on one half an acre, on another three acres, I put on nine ; and I raised as much corn on the half acre, as I did on the other three acres. I soon afterwards joined the R. I. Society for the Encouragement of Domestic Industry, and heard an excellent address delivered to the said society, by the Hon. Tristam Burges, from which I received much instruction. My neighbors soon termed me the Book Farmer, that I was following up book recommendations, putting all my manure on to one small lot, and that I should soon have no farm to manage ; I nevertheless persevered, and put 50 tons per acre on my corn land, and 15 tons per acre on my meadows, when I laid them down to grass, until I had 12 acres prepared in that way ; since which, I have received two premiums from the said Agricultural Society ; one for 102 bushels of corn raised on one acre, and one for a large crop of potatoes. Previous to making the improvement I cut but five tons of hay on my farm, and I now, and have for the last twelve years cut upwards of thirty tons of English hay yearly. A few years since I cleared up and underdrained a cold wet swamp of several acres, which until then had been considered of little or no value. It now produces yearly two tons to the acre. The last season I cut on another lot of one acre, over three tons, and the hay for one year sold in market would pay the whole expense of labor on the same. I believe I am on the road to still further improvement, and am waiting with some impatience for your report of the state survey, and as I am informed by one of the state committee of this survey, that the agricultural part of the survey thus far, can be considered no more than introductory, I presume our Legislature will have it completed two or three years hence, when I hope to give you a more detailed account.

I remain yours very respectfully,

GIDEON SPENCER.

No. 4.

Farm Report of Joseph Childs, Portsmouth, 1839.

Farm consists of ploughed land 21 acres; pasture 6; mowing 16½; orchard 2½; total 46 acres.

Crops.	Indian corn,	300	bushels	on	9½	acres.
	Rye,	32	"	"	2½	"
	Peas, sold green,	100	"	"	½	"
	Potatoes,	800	"	"	4	"
	Onions, 24000 bunches,	1440	"	"	2½	"
	Mangel wurtzel,	200	"	"	¾	"
	French turnips,	200	"	"	¼	"
	Hay,	25	tons	"	16½	"
	Onion seed,	80	lbs.	"	¼	"

Other Produce.

Apples, 75 bushels.
Pumpkins, 6 tons.
Cabbages, 200 heads.
Isabella grapes, 5 bushels.

2000 lbs. beef.
2000 lbs. pork.
300 lbs. butter.

Stock, gross value, $385; viz: 2 horses, 2 oxen, 5 cows, 12 hogs, and 40 domestic fowls.

The cost per acre for the cultivation of each crop, I have no means of ascertaining. I use about 350 large ox-cart loads of manure per year, made from fish, sand, sea weed, green weeds, and the barn-yard and hog-pens. For two years past I have put into the compost, ten casks of lime, which I think has proved decidedly advantageous. I also spread upon the land from 200 to 300 barrels of fish, and 300 bushels of spent ashes. The charges for labor in 1838, which I think will be the same this year, was $504, exclusive of the labor of myself and my wife, who do as much as can be expected from persons seventy-one years of age.

Questions.—(See Judge Durfee's Report, No. 2.)

1st. I change my seeds often, and practise a careful rotation of crops, with every thing except onions.

2d. Have used lime to some extent for two years, and think it does well.

3d. I use 30 or 40 bushels spent ashes per acre, yearly, for onions and grain. They do best for dry land.

4th. Have no peat.

5th. [Not answered.]

6th. Have used fish for 20 years, and think 40 barrels spread on an acre, equal to eight cart loads of common manure.

7th. I use 30 to 40 loads of sea weed, yearly, in the hog-pens, mixed with sand, dirt, and all the green weeds I can collect. The compost is spread upon the onion and potato fields.

8th. I have not.

9th. I soak seed wheat two hours in strong brine, and mix lime with it while wet. This prevents smut, and assists the growth of the wheat.

10th. Onions are the most profitable crop at present; potatoes come next.

11th. This year, onions sold, delivered in New-York, for 50 cents per bushel; rye $1,16; wheat $1,50; and potatoes 28 to 33 cents.

12th. My cattle are stalled in the winter. There is no floor to the stables, but they are provided with sufficient litter, sand, &c., to absorb all the liquid manure.

GENERAL REMARKS.

I conceive there is a great deal of useful information to be obtained from the different agricultural journals. In our state, the land has generally been hard worn by constant cropping and light manuring. Much, however, may be done by every farmer, to restore fertility to his soils and increase their productiveness, if he will make good use of all his resources. Let him employ all hands every *leisure* moment in collecting weeds, leaves, and every article of which manure can be made, into compost heaps for spring use. Let him keep his crops carefully cleaned of weeds during summer, and after the early crops are got in, keep the weeds close, to prevent their going to seed, either by ploughing them in, or removing them to his hog pens, and he may rest assured of a rich reward for his labor and care, in the increase of his crops.

No. 5.

Report of the Crops, &c., raised on the Rivulet Farm, in Cranston, 1839.

The land consists of 15 acres under tillage,
75 " in grazing,
15 " clover meadows,
25 " watered "
30 " river "
50 " in wood,
10 to 15 " peat bog,
5 to 10 " unreclaimed.

Stock.

15 cows,	$570	2 horses,	$110
1 bull,	25	21 sheep,	63
1 pair of large oxen,	160	18 head swine,	108
2 heifers,	50	Turkeys, geese, &c.	44

Produce raised and sold.

Corn on 3 acres, average quantity, 58 b. to the acre,	$150
" 5 " injured by the August gale,	60
Barley and oats, 4 acres,	33
Potatoes, 3 acres, 450 bushels marketable,	150
50 " for feeding cattle,	12
Beets and carrots, valued at	25
Fruit, (not sold.)	
1800 lbs. pork, sold from 7 to 8 cents per lb.	130
Pigs raised,	22
" sold,	8
Lambs, 18 sold at $3 each,	54
Calves, 14, " $5 50 each,	77
Profits in carting wood cut on the farm,	48
7 tons of hay sold, $18 per ton,	126
5 " unsold,	70
1455 lbs. butter sold, at from 26 to 33⅓ cts. per lb.	380
Butter and milk used in family,	30
Premium received on butter exhibited at the R. Island Cattle Show,	15
Received for improvements on the farm,	48
Received for boarding laborers,	32
	$1470

Expenses.

Two hands, each 7 months, at 12½ per month,	$175
1 boy, 7 months,	35
Paid for labor in getting hay,	26
1 hand in winter, 5 months, at $8,	40
1 boy, do.	10
Board of laborers reckoned at $1 per week,	130

Grain, potatoes, and hay seed, used in the spring,	$60
Salt for manure,	10
Salt for dairy,	6
Taxes,	28
Blacksmith's bill,	24
Balance, from which deduct rent of farm and family expenses,	936
	$1470

The farm was not fully stocked, being unwilling in the spring to pay the high prices demanded for neat cattle.

I. A. GARDINER, Tenant.

In reply to your inquiry, what experiments in agriculture have you made? We reply, that on this farm we have made many; some successful, and some otherwise. We will give you as brief a detail as possible of some of them. We irrigate about twenty-five acres of upland, mostly the sloping sides of hills. The water used is from springs that rise on the farm, on the highest land. We formed a reservoir by the erection of a dam, and are thereby enabled to retain nearly all the water that collects in the day and run it on to the meadows in the night, preventing the grass from being scorched or wilted as it would be if put on in the heat of the day. We carry a portion of this water to our barn yards, to our hog pens, and also to our dairy house, where we have put in a water wheel for the purpose solely of aiding the dairy maid in the process of making butter, and find a very considerable labor saved. We intended to have used the water power in churning the milk daily, instead of the cream, in the manner practised by some of the western farmers. We tried the experiment, and found no difficulty in the process, and the butter was excellent, but the quantity fell short so materially that we abandoned it.

We tried the experiment recommended by some Pennsylvania farmers, that of setting the milk partly under ground, and letting the water constantly run round the pans of milk by setting them into excavated shelves. We found that the milk would keep sweet longer and the cream was equally as good, if not better. But here again we found a diminution; so much cream would not rise on the milk. We therefore continue the old mode.

This experiment convinces us, that a milk room should stand separate and apart from any other building, be of good size and height, well ventilated, and shaded with forest trees, and be used solely for that purpose.

We have tried the experiment of flooding land. We built a dam on a small river that runs through the farm, on the sides of which are what is termed intervail or river meadows, (about thirty acres,) and by flowing back we cover the whole extent, and keep them flowed from November to April, when we draw it off and find slime and mud deposited on the surface that enriches it, and our crops of grass have increased thereby, both in quantity and quality. We cart sea weed a distance of from four to six miles, and we think we find our account in it when properly used. It should be spread in hog pens or yards small in extent, and coarse sand, (the best is found on the shores,) mixed with or spread over it, which will be by this preparation converted into fine compost by the swine being yarded upon it. We derive another advantage in putting the sea and rock weed into our hog-yards; they will feed considerably on it, and it serves to make them healthy, and prepares them for fattening.

We use considerable impure salt in our composting. We purchase the sweepings of the vessels holds in which it is imported, and consider it a cheap, valuable material for the purpose.

Some of our neighboring farmers cart salt water from the sea shore, a distance of several miles, and think it better than to let their teams be idle. This they spread on beds of loam, and it is thereby very soon converted into a black mould.

We salt our river meadow hay, putting from two to three pecks of fine Liverpool salt to the ton, and we think we are thrice paid for so doing ; firstly, in the time saved in curing the hay ; secondly, in its increased value, and thirdly, in the salting of the cattle which are fed on it. Besides, we find that low meadow hay, when salted, will not deteriorate if kept several years, and we believe it improves by being kept two years.

We had dug some peat for fuel, and used it to some advantage ; but until we heard the suggestions you made of the possibility that our worn out soils might by the aid of peat be restored, we had not tried it to any extent as a manure. We have since opened a bed on the farm and dug out about 100 loads, at an expense of about 15 cents per load, with which we mixed ten tons of animal manure and six casks of Harris rock lime, which cost, in Providence, $1,25 per cask. The frost pulverized it, and we found it this spring in a good state for spreading on our meadows, and to use on our corn and potato fields. On the meadows we have already ample evidence of its utility.

We have experimented with menhaden fish. For the first and second year they appeared to be a benefit, but afterwards we found the land less productive than it was before the fish was put on, and indeed, in some places, almost barren.

We are of opinion that fish operates on the land like the free use of ardent spirits on the system of the laborer, who, while the excitement is on, is enabled to do more work ; but when it is gone is left in a torpid and enfeebled state.

To Dr. Charles T. Jackson, *State Geologist.*

No. 6.

Farm Report of William Peckham, South-Kingstown, 1839.

Farm consists of ploughed land, 12 acres, grazing 25, mowing 7½, salt marsh and beach 9, orchard 3½, wood 24, peat bog and unreclaimed swamp 4½. Soil, loam underlaid by sand, and gravelly loam.

Crops.

Corn,	100 bushels,		20 bushels to the acre.		
Barley,	25	"	25	"	"
Oats,	125	"	30½	"	"
Potatoes,	270	"	180	"	"
Carrots,	12	"	425	"	"
Beets,	12½	"	600	"	"
French turnips,	110	"	550	"	"
Hay,	10 tons,		1¾ tons		"
Salt marsh do.	2	"			

Other produce.

Pork,	900 lbs.	Milk, estimated	733 galls.
Butter,	205 "	Pumpkins,	20 loads.

Gross amount of all produce, $486 57.

Stock.—Two horses, 2 cows, 2 hogs. Poultry, 36 turkeys, 13 goslins, 65 chickens. Estimated worth of stock, $441.

QUESTIONS.—(See Judge Durfee's Report, No. 2.)

1st. I have used fish, mixed with common soil, to great advantage. Likewise, stable manure, spread and ploughed in, for a potato crop, and the crop was as good, and the potato better flavored, than when manure was used in the hill.

2d. None.

3d. Have used ashes for cabbages several years, and thoroughly tested their value. Use a pint to each hill.

4th. Have not.

5th. Have not.

6th. There is little difference when fish can be obtained at ordinary prices.

7th. Have used sea weeds of the kind indicated, and found them more valuable upon soil of a gravelly nature, than upon stiff loam.

8th. Have not.

9th. Have not raised wheat.

10th. Corn, barley, rye, oats, and potatoes.

11th. [Not answered.]

12th. Have generally put earth under my stalls, and have thought that this mould impregnated with the liquids of the stable, is worth thrice as much as other manure.

No. 7.

Remarks on the soils of the Rotch Farm, leased and cultivated by Mr. Adam Anthony.

I have great satisfaction in laying before the citizens of Rhode-Island, the very lucid and detailed report of Mr. Adam Anthony, who is one of the most intelligent and successful farmers in the state. But few remarks need be added to complete the history of his agricultural operations, and those are such as fall more properly within the limits of my special researches.

Mr. Anthony cultivates a farm leased of Mr. William Rotch, of New-Bedford. The farm is situated two miles north of the city of Providence, and the soil is naturally poor, light and sandy, with some patches of thin swamp, having a light covering of black peat. A large portion of this farm was originally almost barren, or supported only a thin forest of pine trees. By chemical analysis of the natural soil, it was found to be an ancient granite diluvium, charged with decomposed vegetable matters, in an acid state. Hence the theory of his improvements, by means of ashes, containing alkaline matter and lime.

In the experiments reported, upon a trial of lime, I would observe, that the lime employed was of the magnesian variety, and it was found to set into a perfectly hard mass, from its hydraulic peculiarities, so that it was taken out of the hills of potatoes in a solid plate.

Leeched ashes, as before observed in the body of the present report, contains a large proportion of lime, and variable proportions of silicate of potash. It is remarkably hygrometric, or absorbs water readily, and gives it out gradually, to vegetation. The lime and alkaline matters neutralize acid substances, and render insoluble and inert vegetable matters soluble and active, and they neutralize a soil formerly composed mostly of electro-negative substances. From the data we may understand the nature of this important amendment, and shall also perceive by the analyses, that the soil No. 2, has a certain proportion of lime that was wanting in No. 1.

It will be remarked, also, that the proportion of vegetable matter in No. 2 is diminished. This is owing to its having been rendered soluble, and to the fact that crops had been allowed to ripen upon, and were removed from the soil ; thus abstracting a portion of the nutrative substances.

No. 3 has been treated with vegetable and animal manures, hence there is a decided increase of these matters in that soil. It is evident that ashes act by rendering the natural humus of the soil available to plants, and the soil being put into a favorable condition, green crops, drawing nourishment chiefly from air and water, may, by being turned in, contribute to the amount of vegetable matter in the soil. If, however, we merely ash and continue to raise white crops, the soil will be ultimately exhausted of its organic substances.

On Mr. Anthony's farm water stands in his well regularly at eight feet from the surface, and in some parts of the farm within four feet. Were it not from this observation, the soil would have been esteemed porous and subject to infiltration, since it is generally light and sandy, so far as the surface can be examined.

Memorandum furnished by Mr. Anthony.

These three specimens of soil were originally of the same character, but now possess different degrees of fertility. No. 1 is its natural state, and would produce no more than ten bushels of Indian corn to the acre ; probably less of any other grain, and no hay at all. No. 2 has been improved by ashing only. This has produced the present season a ton and a half of clover to the acre, and would probably grow thirty bushels of corn without manure. No. 3 is in a higher state of cultivation, and has produced in a three years rotation, sixty bushels of corn, fifty of oats, and two tons of hay per acre, with a dressing of six cords of stable manure the first year, and sixty bushels of ashes the second, per acre.

Analyses of Mr. Anthony's soils from the Rotch farm in North Providence.

Mechanical separation of the particles.

Soil marked No. 1. 1*st sieve*—pebbles of granite, 14. 2*d sieve*—sand and fibre, 165—fine soil, 821=1000.

Soil marked No. 2. 1*st sieve*—pebbles of granite, 44—2*d sieve*—sand and fibre, 161—fine soil, 795=1000.

Soil marked No. 3. 1*st sieve*—pebbles of granite, 38—2*d sieve*—sand and fibre, 183—fine soil, 779=1000.

Chemical analysis of the soils.

	No. 1.	No. 2.	No. 3.
Water of absorption	1.80	2.20	1.55
Soluble veg. matter,	2.50*	1.60†	4.60‡
Insoluble veg. matter	2.00	2.15	1.50
Per-oxide of iron	2.10	2.50	2.07
Alumina	2.10	2.75	1.39
Magnesia	1.00	traces.	
Phos. and Cr. lime		1.20	traces.
Insoluble silicates	88.20	88.20	89.10
	99.70	100.60	100.21

The specific gravity of these soils is 1.485, and they weigh 92,178 pounds to the cubic foot. The soil No. 1 was also examined by means of the fixed alkalies.

A solution of 50 grains of potash in 4 ounces of water, being digested upon 100 grains of the soil, took up 3.7 grains, which was then analyzed in the manner described for the separation of the crenic and apocrenic acids. The alkaline solution being slightly acidulated with acetic acid, a solution of acetate of copper was dropped in, when an abundant brown precipitate, which was apocrenate of copper, subsided, and after separation was collected on a filter, washed, dried, and weighed on counterpoised double filters. The apocrenate of copper weighed 2 grains, and being decomposed left deut-oxide of copper weighing 0.2 grain, hence by difference the apocrenic acid was 1.8 grains.

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*No. 1, consisting of		
	Crenic acid	0.70
	Apocrenic acid	1.80
		2.50

†No. 2 consisting of the crenic and apocrenic acids.

‡No. 3 containing		
	crenic acid	0.10
	apocrenic acid	1.00
		1.10

The solution from which the apocrenic acid had been separated was rendered slightly alkaline by a solution of carbonate of ammonia, and acetate of copper being dropped in, threw down an abundant greenish white precipitate of crenate of copper, which being collected and decomposed by sulphuretted hydrogen yielded 1.7 grains of crenic acid.

The same operations were repeated on the soils Nos. 2 and 3 with similar results, excepting that in No. 3 there is a certain portion of soluble manure which does not consist of these acids, but is in some unknown state, originating probably from incomplete putrefaction of the animal matter.

Subsequent to the above analyses I received from Mr. Owen Mason another specimen of the barren sandy soil from Mr. Anthony's farm. It was taken from the pine barrens, where there had never been any improvement of the soil. I examined the specimen marked A, on Mr. Mason's memorandum. 1000 grains of this soil in a dry state digested at a boiling heat in a solution of 50 grains of carbonate of potash, dissolved in 4 ounces of water, and the solution being poured off upon a filter and renewed so long as any color was extracted, lost 17 grains of vegetable matter, with a little silica and alumina which are taken up by the fixed alkali.

The same quantity of the dry soil digested in a solution of carbonate of ammonia, at a temperature below boiling, the solution being renewed in the same manner, so long as any color was extracted from the soil, lost 14 grains of vegetable matter. The remaining soil being burnt in a platina crucible, lost 21 grains of insoluble vegetable matter.

The soil weighing 92 pounds to the cubic foot, and one half that weight being allowed, since the depth of tillage is but 6 inches. An acre of soil contains 43,560 square feet.

We may calculate the contained vegetable matters thus:

Sq. ft. to acre.		1-2 cubic ft. of soil.		lbs. to acre, 6 inches deep.		per cent of sol. vegetable mat.		
43,560	×	46	=	2,003,760	×	1.7	=	$\frac{3406392}{100}$

$\frac{34063.92 \text{ lbs.},}{2000}$ = 17.031 tons of soluble vegetable matter in an acre of the soil.

17.032 tons soluble vegetable matter, nearly
21.039 tons insoluble vegetable matter.

38.071 tons of vegetable matter per acre, 6 in. deep.

It is evident that this soil contains vegetable substances in an acid and inert state, and that by spreading ashes and lime upon the soil, they may be rendered available to vegetation.

It should be remarked here, that by soluble vegetable matter, I mean those matters that may be rendered at once soluble by carbonates of ammonia, potash, soda, and by the alkaline earths.

The mineral matters in this soil are identical with those in soil No. 1, before reported. No trace of lime was discoverable, even on analyzing 1000 grains of the soil.

Much labor and time were devoted to the examination of the soils from Mr. Anthony's farm, because they represent the nature of extensive agricultural districts in the State; and we had also the satisfaction of knowing that we should obtain from that skilful farmer, exact statistical returns.

Farm Report of Adam Anthony, North-Providence, 1839.

Farm consists of

Ploughed land,	30	acres,	valued at	$141	per acre.
Pasture,	26	"	"	70	"
Mowing,	18	"	"	150	"
Wood,	30	"	"	40	"

Crops.

Corn, 258 bushels; 64½ bushels per acre. Soil, sand and sandy loam. Manure, 7 cords per acre.

Potatoes, 592 bushels; 236 bushels per acre. Soil, sand and sandy loam. Manure, 7 cords per acre.

Turnips, 1300 bushels; 650 bushels per acre. Soil, sand and sandy loam. 240 bushels ashes; Manure, 3½ cords per acre.

Barley, 10 tons; 1¾ tons per acre; cut for fodder. Soil, sand and sandy loam.

Hay, 50 tons; 2¾ tons per acre; 5 acres upland, 3 lowland; sandy; 10 of reclaimed peat bog; 2 acres of upland, top dressed with 5 cords manure per acre.

Millet, 40 tons; 2¾ tons per acre. Soil, sandy; 4½ acres, no manure, 10 ashed 100 bushels to acre.

Pumpkins, 5 tons from among corn.

Other Produce.

Beef, 9500 lbs. Pork, 567 lbs. Milk, 8764 gallons.

Cost of cultivation per acre.		Value of crop.	Stock.	Value.
Indian corn,	$49	$87 25	1 horse,	$50
Barley,	27	31 00	2 oxen,	70
Potatoes,	46	78 00	18 cows,	648
Turnips,	47	116 00		
Hay,	24	49 00		
Millet,	24	49 00		

North-Providence, 12 mo. 2, 1839.

Dr. C. T. Jackson,

Esteemed Friend—Having filled such of the blanks in the form appended to the circular as were necessary to the requisite statements respecting my crops of this year, I avail myself of the convenience of a separate sheet to notice such of the questions as I am able to answer.

I have made no experiments that have been sufficiently carried out to be of other importance than as affording suggestions for further trial and more accurate and extended observation. Of this character are those with nitre, potash, &c., of which a statement has already been given. It may be well, however, to repeat it here. Seven plats of ground, each containing a rod, half a rod apart, on a field of sandy soil which had been recently sown with millet, without manure, were treated in the following manner. One with lime, one with ground oyster shells, and another with salt, four quarts to each. One with a peck of recent, another with the same quantity of spent ashes. The next with potash, and the last with saltpetre, each a pound. The lime and oyster shells produced no effects, the millet being no better than on the undressed ground about them. Salt had been furnished in too large a quantity, and destroyed most of the seed. The few plants that came, however, grew very luxuriantly. There was no perceivable difference in the ashed portions, the crop being alike better than on the intermediate spaces. Potash and nitre gave the best results, the latter the most striking. The ground was in fine condition. It produced at least three and a half tons of millet to the acre, and, as before stated, was No. 3 of the soils furnished for analysis.

I have tried lime in but a few instances, and not at all in composts. In a potato drill, on a sandy loam, it was evidently injurious to the crop, and as a top dressing for grass grounds, one a sandy soil, the other a reclaimed bog abounding in vegetable matter, it was of no perceivable benefit.

Spent wood ashes have been the principal manure which I have used in amending the condition of light loams, and sandy and gravelly soils. On all these they are used to great advantage ; and to a profitable result in the improvement of the two last mentioned, combined with the growing of clover they are almost indispensable, especially if the soil be of very sterile character.

Besides the experiment above noticed with ground oyster shells, I have applied them to sandy and to loamy soil for grass and for turnips, but without effect.

Bog mud of peaty character has been used to some extent in my manure trenches, and is deemed excellent for the purpose—more valuable than loam.

On the sandy and poorer grounds of the farm millet and clover are the most profitable crops. On those of firmer texture the root culture has given the best results. A part of the difference in the superior profit, however, is but apparent. Requiring most, or all of the season to perfect their growth, they prevent, without some intervenient crop, late summer or early fall seeding, the seasons, I believe, in which lands in high condition are most profitably laid down to grass. The value of the produce of the farm this year, inclusive of pasture feed and the products of garden grounds, (included in the ploughed land, but not otherwise noticed,) is $2840. And it appears on examination of my accounts that its conversion into the forms in which most of it is disposed of, is not likely to give a very dissimilar result. Sales have been made to the amount of $2962,84, and there is on hand $669, worth more than at the commencement of the year. To this should be added $600 for the manure made by the stock, making in the aggregate $4231,84. From this sum should be deducted the cost of the grain purchased, and the hogs and cattle fatted, which amounts to $1214,65, leaving a balance of $3017,19, as the value of the produce. The excess over the first estimate of $177,19, will probably defray all extra expense incurred by the disposition which is made of it.

The liquid manure from the stock is saved, but has never been separately applied. Both this and the solid matter are received into a trench in the rear of the cattle stalls, and with the admixture of bog mud or loam, make a compost much more valuable than ordinary stable manure.

Six dollars a cord for it, may be thought to put an end to all profitable results in farming, but the effects of its application sustain me in this opinion of its value. It is charged at five dollars, in my estimates of the cost of crops, one sixth part, I consider, as being appropriated by the soil to its own improvement.

I have limited my estimates in regard to crops, to such only as have been raised on the farm this year. There are others, in the culture of which, I have had some experience ; such as oats, beets, and carrots. Oats, in general, give about the same results as barley. Beets and carrots cost more in the cultivation than ruta baga ; beets, perhaps six, and carrots, $12 an acre. The product, with me, has been about the same, and they are probably of equal value. The difference, if there be any, as food for stock, has escaped my observation. In regard to beets, however, I speak only in reference to the scarcity, and yellow French. The white and red are said to be of better quality.

In the valuation of the lands of the farm, buildings have not been included. These, exclusive of the dwelling-house, would add about twenty per cent to their value, and of course, about one and a half per cent to the cost of crops as interest.

For some further account of the method pursued in my farming operations, and for the result for 1838, allow me to refer thee to a letter addressed to Henry Colman, published in No. 48 of the New-England Farmer, for the current year. Respectfully, and very truly thy friend,

ADAM ANTHONY.

No. 8.

The following Report was received from Daniel P. Dyer, who cultivates a farm and nursery garden, situated two miles west of Providence. It contains a very useful illustration of the beneficial application of lime to acid soils.

I have examined the farm described. The tract of land referred to in the report, forms the summit of a hill that was originally covered with numerous boulders of rock, and was in a most unpromising condition. The soil on the sides of the hill is still in its natural state, and is nearly barren, there being only a scanty growth of fine top grass, and dry white moss on its surface, indicating a sterile condition. On the smmit of this hill the soil was originally of the same character; but after the improvements described, it became very fertile, so that it produced one of the largest crops of clover that I have seen in the State. Mr. Dyer seems to understand clearly that lime is not introduced as an enriching manure, but as a chemical reagent, to act as an amendment, it being a decomposing and neutralizing substance, capable of bringing the soil into a fertile state when the proper substances are presented for it to act upon. In an exhausted soil, it is evident that animal and vegetable manures ought to be added, and then the lime will aid in converting them into a proper food for plants.

Mr. Dyer's Statement.

Product of a lot of land on Rocky Hill, containing 6½ acres, ploughed in the autumn of 1835; about 600 bushels of lime were sowed broad cast after ploughing, and in the spring a small quantity of manure was spread on the top of the lime and harrowed in, and then sowed with barley and oats. One corner of the lot had manure spread on it without lime, and the product was lessened one half—the lime about one half shell and the other from the bleachery.

In the autumn of 1836 I ploughed the same lot, and in the spring of 1837 spread a good coat of manure on, say five or six loads to the acre, and cross ploughed and planted it with potatoes, in drills. The crop was very good—1427 bushels.

In the spring of 1838 I manured it again, and ploughed and harrowed and sowed it with barley, oats, and hay seed (herdsgrass, clover, and redtop,) about one bushel to the acre, and had sixteen loads of barley and oats, say one ton to the load.

In the spring of 1839 I manured about one half the lot, say four and a half cords of manure, half a cord of lime and ashes, and cut 16 loads of hay—I should think about 18 tons, of clover, herdsgrass and redtop.

This lot was covered with bushes, like the land around it which you saw.

I have given you a short account of the crop from a lot of land which you saw on Rocky Hill last summer. I find lime on cold clayey soil to do well, and on peat soil a mixture of peat, loam, lime, and sand, makes very good manure for grass.

Yours, &c.

DANIEL P. DYER.

No. 9.

PROVIDENCE, 3d mo. 28, 1840.

C. T. JACKSON,

Esteemed Friend—If any thing in the following hastily sketched items will aid thy purpose, thou art welcome to its use. I should have been glad to give thee more definite information, if I had a more definite idea of what would be desirable. I shall be willing to contribute to the purpose whatever else may present. Please suggest any farther inquiry.

New-England Yearly Meeting Boarding School, at Providence, R. I.

The tract of land connected with this Institution, was given to the New-England Yearly Meeting of Friends by that benevolent patron of learning, the late venerable Moses Brown. The farm is situated about one mile northeast of the city market, and is included within the city limits. Its surface is somewhat diversified—its highest point being at an elevation of nearly 200 feet above the level of the sea. From careful admeasurement, often repeated by the students, its area is 42 acres, 3 rods, and 25 perches. The character of the rocks and soil is very similar to that of the surrounding lots.

Numerous boulders of iron stone occur on the farm and in its neighborhood, varying in size, but generally from six to twelve inches in diameter. They are, probably, from Cumberland Hill, the "large hill of magnetic iron ore," alluded to by Professor Hitchcock, (Rep. p. 156,) and in connexion with the occurrence of these boulders, (traceable as they are, to the south end of the island of Rhode-Island,) adduced by him to aid in an important geological deduction.

There are on the premises two fine groves, which, during the summer term afford to the students a very pleasant resort for recreation. The most abundant wood on the farm, is walnut. Besides this, however, are several varieties. The following sketch will give an idea of the "dendrology" of the school farm ; some kinds being named of which there are but few trees :

Elm,	*Ulmus Americana,*
White oak,	*Quercus alba,*
Red oak,	*Quercus rubra,*
Black oak,	*Quercus nigra,*
Sycamore,	*Platanus occidentalis,*
Chesnut,	*Castanea Americana,*
Walnut,	*Carya alba,*
Red maple,	*Acer rubrum,*
Rock maple,	*Acer saccharinum,*
Beech,	*Fagus ferruginea,*
Cedar,	*Cupressus thyoides.*

And numerous young fruit trees.

The agricultural returns are hardly sufficient to give an idea of the relative fertility of the soil. As is generally the case with such establishments, the principal attention of those concerned has been devoted to the literary interests of the institution—while in addition to this circumstance, several changes have taken place in the management of the farming department. A few articles of produce may be named, however, as follows :

Hay, 7 acres,	12	tons.
Potatoes, 2 acres,	550	bushels.
Barley, 1 acre,	33	"
Beets, half an acre,	275	"
Peas, 1 acre,	32	"

The farm yields a considerable supply of vegetables for use during the summer.

Sufficient hay and other fodder are produced to support six cows and two horses.

Attached to each department of the institution is a garden spot in which each member of the schools may have an individual interest. One of these, consisting of nearly an acre, contains numerous flourishing young trees and a considerable variety of shrubbery.

I doubt whether much contained in this sheet will be of service to thee, but if any part appears so thou may make such use of it as thou pleases.

With regard, thy friend,

SAMUEL AUSTIN.

No. 10.

Agricultural Statistics collected on Connanicut Island.

Mr. D. W. Clarke cultivates the Prospect Hill farm, near Mackerel Cove, an estate comprising about 275 acres of land. Much of the land that originally cost $60 per acre, is said now to be worth $100, owing to skilful improvements.

The soil is good, but Mr. Clarke says, that owing to a sandy subsoil, it is subject to leeching. The produce of this farm is from 40 to 50 bushels of corn, 50 of barley, or of oats, 125 of potatoes, and from one to one and a half tons of hay per acre. Barn yard and sea weed manure are used. The stock kept on the farm consists of 16 cows, 4 yoke of oxen, and 20 swine. Butter and cheese are made on this estate for the market.

The clear profit on the capital invested in the farm, is five per cent, and the land is increasing in value.

At the northern part of the island, Mr. Watson cultivates a farm, and he states that his crops of Indian corn will average 25 bushels to the acre, and of rye 8 or ten bushels, and hay one quarter of a ton per acre.

Eel grass and other sea weeds are used for manure, after being rotted in the barn yard, ten loads being spread to the acre. The soil appeared tō be rather poor, and requires much larger supplies of manure to render it fertile. (See analyses of these soils in the appended tables.)

Agricultural Statistics collected on Pappoosesquaw's Neck, Bristol.—James Perry's Farm.

Crops.

Turnips,	600	bushels,	
Mangel wurtzel,	600	"	
Onions,	400	"	
Carrots,	300 to 400	"	with the onions.
Corn,	30	"	
Barley,	25 to 30	"	

Hay, one half ton on an average per acre.

Eel grass costs $1 per ton, and is used, after being rotted in the yard, for manure.

Mr. C. F. Herreshoff has a farm of 230 acres on Pappoosesquaw's Neck. His crops were, per acre,

Corn,	20	bushels, average of five years.
Barley,	25	"
Onions,	300	"
Potatoes,	150	"
Grass,	1	ton.

Potatoes are said to be the most profitable crop. Eel grass, composted in the yard, is used for manure, 15 to 20 loads being applied per acre. An extensive bog of excellent peat and swamp muck, containing 50 acres area, the peat being from two to four feet deep, exists on this farm, and is entirely neglected. I trust it will not be allowed to remain useless, when it is capable of being made into a compost manure vastly more valuable than that now used on the farm.

The soil of Pappoosesquaw's Neck is very favorable to the growth of carrots. Mr. Thomas Church has, during the present year, obtained very heavy crops of excellent quality.

BARRINGTON.

Mr. Christopher Smith, of Barrington, has cultivated his farm successfully, and reports the following as his average crops per acre :

Corn,	50	bushels,
Carrots,	500 to 600	"
Mangel wurtzel,	600	"

Hay, from two to three tons per acre.

Sea weed and barn yard manure, in equal proportions, are composted together, 20 loads of the mixture being spread per acre, on the soil.

I took a specimen of soil from his corn field, which was said to be cold and liable to moss. This was analyzed. (See tables.)

The average grass crop in Barrington is stated at a ton and a half of hay per acre.

Abstract of the Report of No. 11.

William French, Esq. of Kingston, cultivates a farm of 13 acres, inclosed in one quarter and two acre lots, four acres and a half of which is pasture. He tills all his farm excepting the pasture, ploughing four inches deep, and rotates his crops as follows: 1st year, corn; 2d, potatoes; 3d, oats, barley, or wheat; and then lays down to grass. He uses 20 loads of barn yard or hog pen compost manure per acre; spreads, harrows and bushes the manure in the furrow; chains rows across in two directions and three feet and a half apart; plants from 6 to 9 grains of corn, selected from the best ears, in each chain mark, and endeavors to obtain a crowded crop of young corn, since he thinks this prevents suckers from growing.

He plants about the 10th of May, and obtains a crop of about 40 bushels of corn to the acre.

He plants his cut potatoes in drills, two inches and a half deep, and spreads 20 loads of manure to the acre. His crop amounts to 250 bushels of potatoes to the acre.

He sows four bushels and a half of oats, three bushels of barley, or one bushel and a quarter of spring wheat, per acre, spreading broad cast 15 or 20 pounds of clover and one peck of herdsgrass, and furze top seed at the same time. In good seasons he obtains 40 bushels of oats, 30 or 35 of barley, and 20 of wheat, per acre.

His mowing land is about three acres and a half. After cutting his grass he spreads manure on the sward as soon as the hay is taken off.

The produce of his farm in 1838, was as follows: Nine tons of hay, 250 bushels of potatoes, 10 of barley, 35 of corn, 5 or 6 loads of pumpkins, 15 bushels of round and 5 of French turnips.

He summered 2 cows, 1 yearling, and a horse.

Mr. French is quite peculiar in his opinions about swine, and prefers the long-legged, slab-sided, and long-eared species, and maintains that they are most profitable. He gives the following account of one of his hogs, which he bought on the 25th of March, 1839, when he weighed 140 pounds.

June 22, his weight was	304—164 gain in 87 days.
July 9,	336— 32 in 16 days.
August 31,	440—104 in 52.
September 17,	474— 34 in 17.
October 4,	510— 36 in 17.
28,	544— 34 in 24.
November 30,	580— 36 in 32.
	580 245.

His growth was on an average 1 lb. 12 1-2 oz. per day. His length from snout to root of tail, was seven feet.

Mr. French recommends the keeping of pine boughs in the sheep cot in winter, when the yews are with lamb, and says that it prevents mortality among them. He advises weaning the lambs on dry feed, such as corn stalks, &c. He advises the rearing of young calves on porridge and hay, instead of letting them go to the cow, and says that it is more economical, and that the calves feed better afterwards.

The above summary contains most of the facts and opinions which have been furnished me by this gentleman. His report is too long for insertion entire.

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PLATE I.

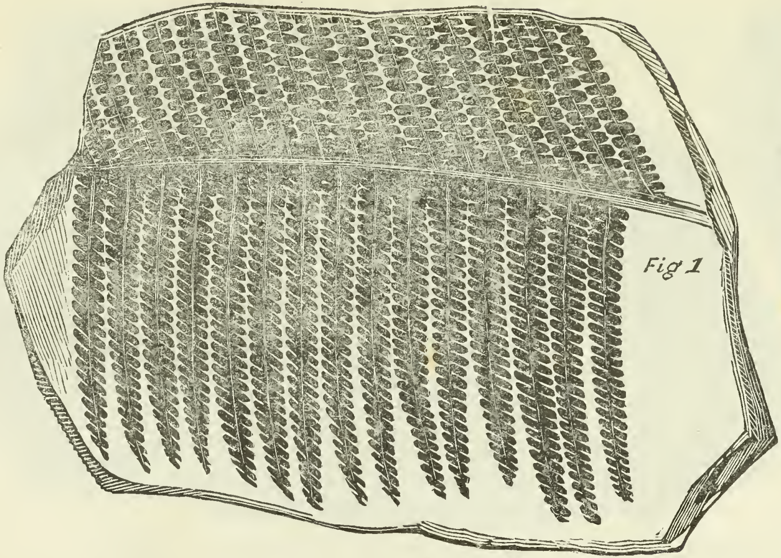


Fig. 1.—Pecopteris arborescens, Warren, R. I.

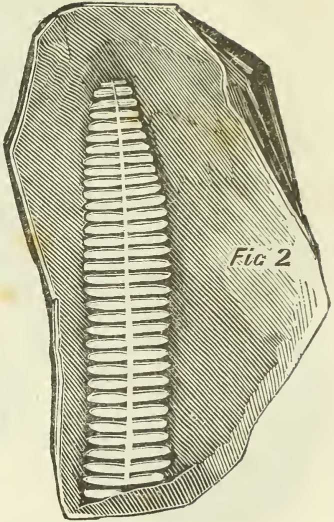


Fig. 2.—Pecopteris, Bristol Neck, R. I.

PLATE II.

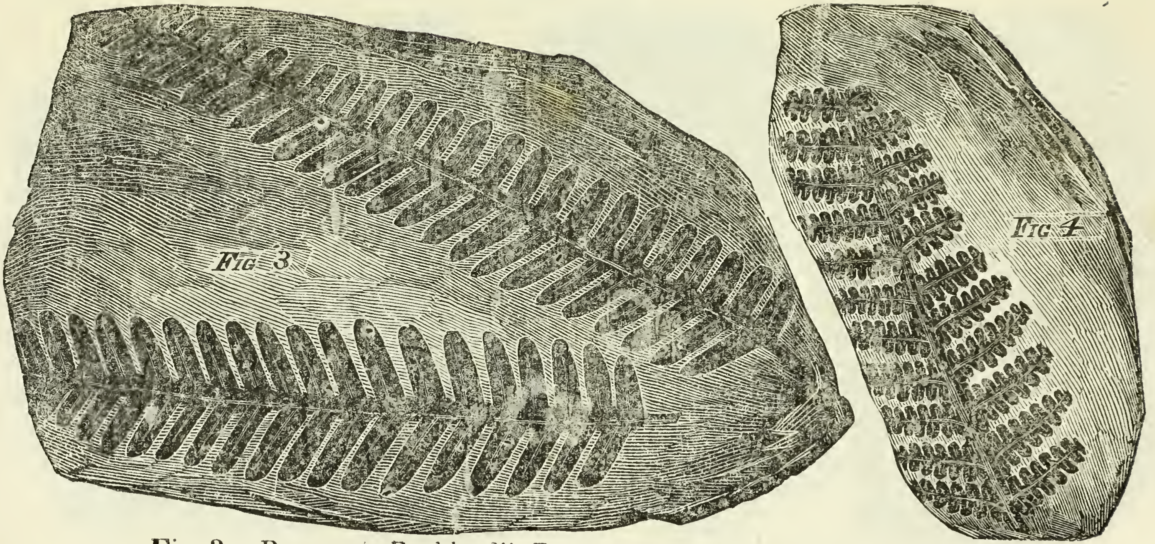


Fig. 3.—Pecopteris Bucklandii, Brogn., near Holden's, Warwick Neck.
Fig. 4.—Pecopteris Unita? Warren.

PLATE III.

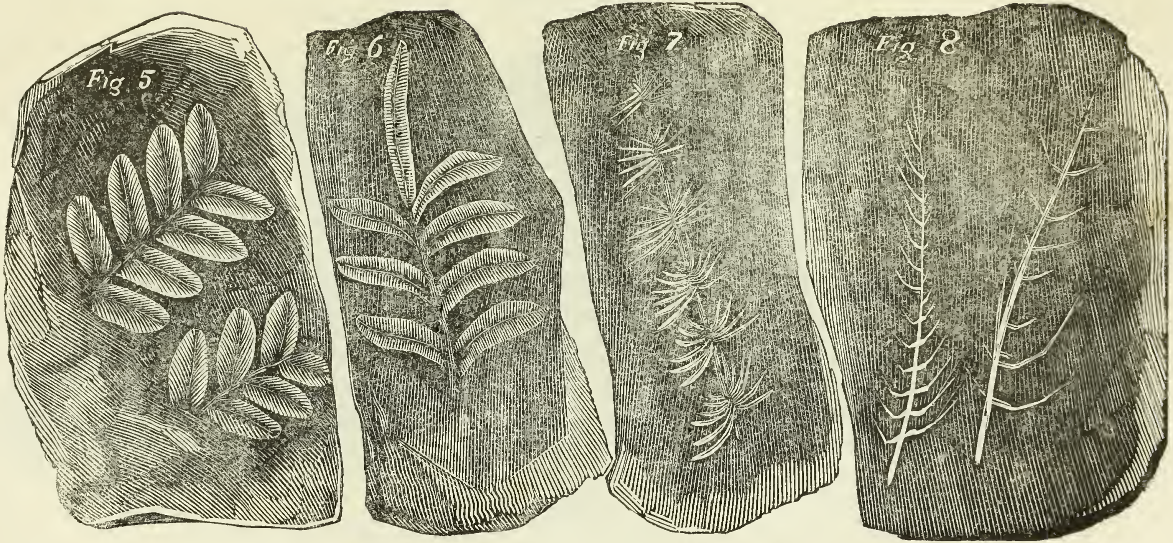


Fig. 5.—Pecopteris. Fig. 6.—Pecopteris Serlii, Brogn., Wrentham and Mansfield. Fig. 7.—Equisetum ? Warwick Neck. Fig. 8.—Fuci ? Warwick Neck.

PLATE IV.

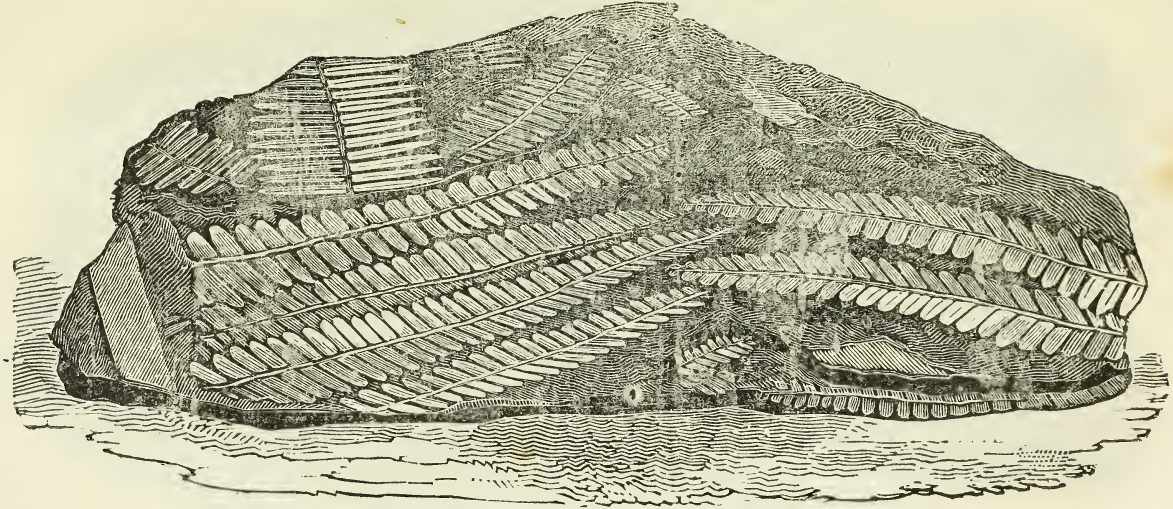


Fig. 9.—Pecopteris Cyathea? half size, Portsmouth, R. I.

PLATE V.

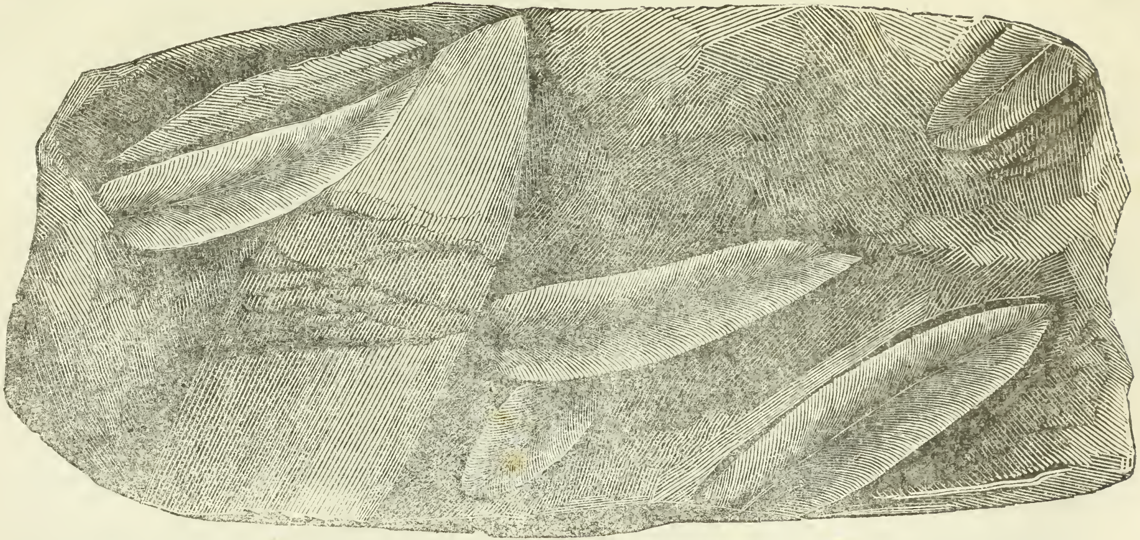


Fig. 10.—Neuropteris Scheuchzeri, Brogn., Newport Neck, R. I., and Mansfield, Mass.

PLATE VI.

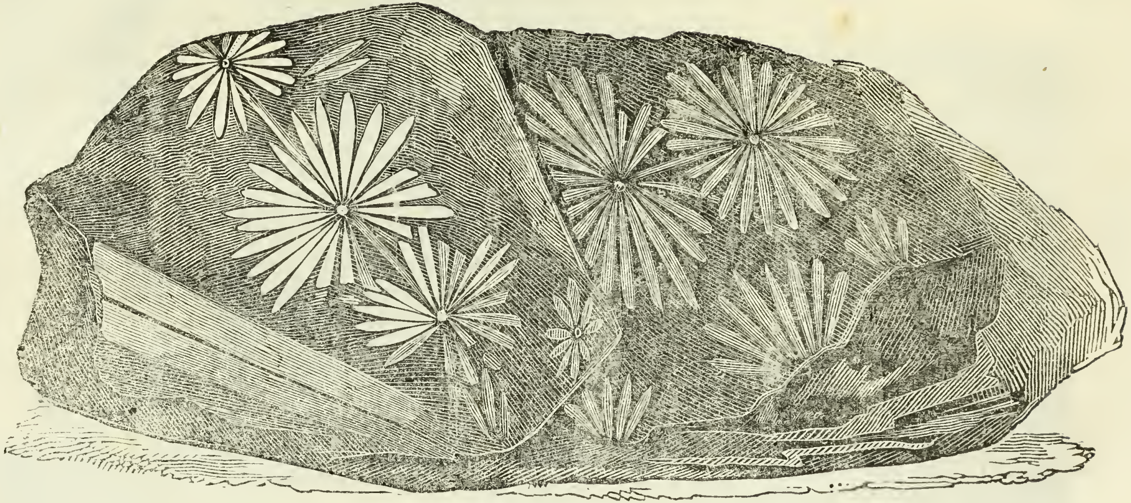
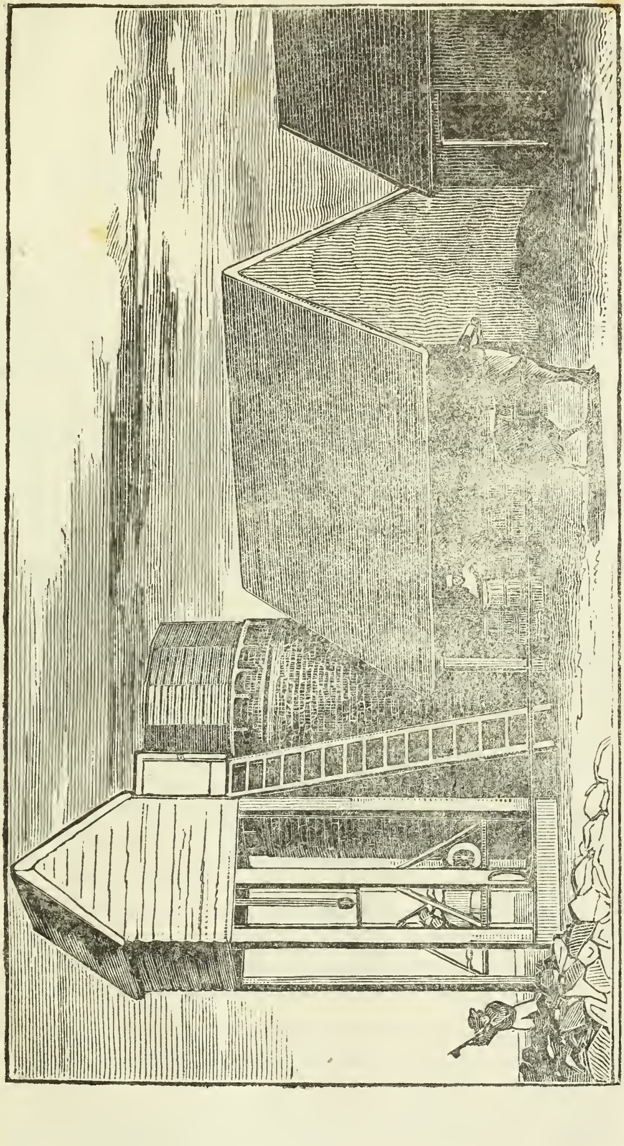


Fig. 11.—Asterophylites, Newport Neck, R. I., Warren, R. I., and Mansfield, Mass.

PLATE VII.



Perpetual Lime Kiln, belonging to Mr. Gould, of Charlestown, Mass.

EXPLANATION

OF

GEOLOGICAL TERMS.

The following brief glossary of such terms as cannot be found in the ordinary dictionaries, is republished from my first Report upon the Geology of Maine.

ALLUVIUM, consists of clay, sand, and gravel, washed from the surface of hills and mountains, they being transported by currents of water, such as torrents, rivers, and brooks, from the high lands, and deposited along their course. Etym. *alluo*, to wash upon.

AMORPHOUS, a word derived from the Greek, signifying without regular form.

AMYGDALOID. One of the forms of trap-rocks, the trap being full of rounded holes filled with various minerals, bears some resemblance to an almond cake, and the name is derived from the Greek, signifying *like almonds*.

AMYGDALOIDAL TRAP, is produced by the contact of trap with other rocks, where a chemical action was exerted, and the trap being in a molten state, was blown into a scoria-like form, by the gases or steam disengaged. The cavities are generally filled with infiltrated minerals, such as calcareous spar, chlorite, agate, &c. Similar appearances are seen in lavas of modern volcanoes, and they may be produced at will in the slag of any iron furnace, by allowing the slag to run over moistened sand. Various forms of lava may thus be produced, from the compact and glassy obsidian to perfect pumice stone.

ANDALUSITE, is a mineral consisting of alumina, silex, and a little oxide of iron, found first in Andalusia, in Spain—hence its name.

ANTHRACITE, is a very hard kind of coal, destitute of bitumen. It burns without smoke, and with very little flame. Its name is from the Greek, signifying *coal*.

Apophyllite, a simple mineral, sometimes called fish-eye stone.

Argillaceous, means composed of clay. Etym. *argilla*, clay.

Argillite, slate rocks composed of clay in a hardened state.

Alumina, pure clay. It is seldom found pure in nature. It is the material which gives adhesiveness to all soils.

Basalt, a variety of trap-rock consisting of pyroxene, felspar, and iron.

Beds, are masses of mineral matter included *between strata* of rocks, and running in the same direction as the strata. If you place a book between the leaves of another book, it represents a bed between the strata.

Bitumen, is an inflammable substance. It presents itself in a solid form and is then called asphaltum. In its liquid form it is like tar, and is called petroleum, and from it may be distilled a clear liquid called naptha. Bituminous coals contain this substance, which causes them to burn with a bright yellow flame and with smoke. Etym. *bitumen*, pitch.

Blende, a German name for sulphuret zinc.

Boulders, a provincial term for rounded blocks of stone lying on the surface of the earth, or imbedded in the soil. They have evidently been transported, by the action of water, far from their native beds.

Breccia, a word from the Italian, signfying a rock composed of *angular fragments* cemented together. This term is synonymous with the term tuff. Thus we have trap-tuff, or breccia of trap, &c.

Buhrstone, a kind of silicious stone overlaying the *calcarire grossiere* of Paris. It is used for millstones.

Barilla, an impure carbonate of soda, procured from the ashes of sea weeds. Kelp is a still less pure carbonate of soda, obtained from the same source.

Calcareous, signifies a rock containing lime, the term being derived from the Latin *calx*, lime.

Calcareous Spar, is crystallized carbonate of lime.

Carbon, an elementary substance. In its pure crystallized state it is the diamond. Graphite, or plumbago, is composed of carbon. Carbon is the basis of charcoal, and of all kinds of coal. Etym. *carbo*, coal.

Calciferous, containing lime.

Carbonate of Lime, is lime combined with carbonic acid. Carbonic acid is composed of carbon and oxygen, and lime is composed of a metalic base called calcium, and of oxygen. Carbonate of lime, when heated red hot, loses its carbonic acid in the form of gas; but if it is heated under pressure equal to a column of 1700 feet of water, or 600 feet of liquid lava, it simply melts and crystallizes, without losing its carbonic acid.

Chloride, a combination of chlorine, a chemical element, with a metallic substance or base. Thus chloride of sodium, (sea-salt,) is a combination of chlorine, with the metallic base of soda or sodium.

Coal Measures, the strata of rocks which contain coal, used synonymously with coal formations.

Crystal, a regular geometrical solid, produced by the arrangement of symmetrical particles. The name was first applied to transparent substances in regular forms. The derivation of the name is from the Greek, signifying *ice*.

Chert, a mineral consisting of silex, alumina, and lime, of a compact texture like flint. It is sometimes produced by the action of trap-rocks upon slate containing lime.

Chlorite, a green mineral composed of delicate scales, or in a compact form. Its name is from the Greek, signifying *a green stone*.

Dip, the angle which a rock makes with the horizon. Stratified rocks have the dip always at right angles with their direction. Place a book sloping on the table, the slope is the dip, and the course of the leaves represents the direction of the strata.

Dislocation. A vein, bed, or the strata of a rock may be thrown out, so that they do not coincide; then they are said to be dislocated, or to have a fault.

Dolomite, a granular variety of magnesian limestone, named in honor of Dolomieu, a distinguished geologist.

Dykes. This term is of Swedish origin, and signifies in geology, a wall or vein of rock which intersects another rock. Dykes always originate from below, and cut through the superincumbent rocks.

Drift, the name given by miners to a horizontal passage excavated in a mine.

DRUSES, cavities whose interior surface is lined with crystals; they occur most frequently in veins.

DETRITUS, disintegrated materials of rocks.

DILUVIUM, deposits of boulders, pebbles, sand, and gravel, which many geologists have supposed were produced by a diluvial wave or deluge sweeping over the surface of the earth.

EPIDOTE, a simple mineral of a green color.

ELVAN, an English provincial term applied to a variety of porphyritic compact felspar.

FAULT. [See Dislocation.]

FELSPAR, a mineral composed of silex, alumina, and an alkali, found abundantly in granite. Its name is from the German.

FOSSIL, a name given to petrified organic remains dug out of the earth or rocks.

FERRUGINOUS, means containing iron. Etym. *ferrum*, iron.

FORMATION, a group of rocks or of strata of earth, referred to a common origin or period.

FUCI, marine plants.

GALENA, an ore of lead composed of lead and sulphur.

GNEISS, a stratified rock composed of layers of quartz, mica, and felspar.

GRANITE, an unstratified rock composed of mixed crystals of quarts, felspar, and mica, united without any cement. It is a rock of igneous origin.

GRAPHITE, a mineral composed of carbon and a small quantity of iron, varying from one to ten per cent. It is improperly called black lead or plumbago. The name graphite is from the Greek, meaning a stone which will mark or *write*.

GRAU-WACKE, is a rock composed of various pebbles united by an argillaceous cement. It is generally of a grey color. Its name is of German derivation. This rock is one of the transition series, and is generally found alternating with argillaceous slate of the same age. In our country it frequently includes valuable beds of anthracite.

GREENSTONE TRAP, a rock composed of hornblende, felspar, and oxide of iron. It is a rock of igneous origin, and was thrown up from below granite. It cuts through and overlays the new red sandstone formation. Its name is from its green color, and the word trap is from the Swedish word *trappa*, step or stair, these rocks being often arranged in broken columns like stairs.

Gypsum, a mineral composed of sulphuric acid and lime, generally containing 20 per cent of water.

Hornstone, a silicious mineral resembling flint in hardness and in fracture.

Hornblende, a simple mineral of a dark green color, approaching blackness, crystallized in long prisms, or massive.

Hydraulic Cement, a substance which is used in subaqueous works, the cement having the property of hardening under water.

Hematite, a valuable iron ore.

Jasper, a silicious mineral generally of a blood red color, containing oxide of iron and alumina.

Laminæ, signifies delicate leaves or layers of which some minerals are composed.

Lithia, an alkali, found only in certain minerals.

Manganese, the oxide of manganesium, a metal. Its ores are grey, black, and red.

Marl, a variety of clay containing carbonate of lime. It falls to powder on drying, and will effervesce when acids are poured upon it.

Mica, a mineral found in granite rocks. It is found in crystals and in plates, which split into thin leaves not more than $\frac{1}{10000}$ inch in thickness. It is elastic, and springs back when bent, which property distinguishes it from talc. Etymology, *mico*, to shine.

Novaculite, a compact kind of slate used for whetstones.

Nephrite, a simple mineral, composed of silex, lime, soda, and alumina, with some metallic oxides; it is remarkable for its toughness, hardness, and frequently for its fine colors.

Outcropping, the edges of strata of rocks where they appear at the surface.

Petrifaction, an organic substance converted into stone.

Porphyry, a rock composed of compact felspar, with little squares of felspar in its mass. Rocks having crystals of felspar thus included, are said to be porphyritic.

Primary Rocks, are supposed to have been formed first in the series. They never contain any organic remains of animals or vegetables. Granite, sienite, gneiss, mica slate, &c., form what are called primary rocks.

Prot-Oxide, Per-Oxide, terms signifying the lowest and the highest degrees of oxidation, oxidation meaning the combination of oxygen with any substance. Thus when iron rusts, it is converted into an oxide. The oxygen of the air combining with the iron.

Pyrites, a combination of iron, or iron and copper, with sulphur, is called by this name. It originally was given because iron pyrites gave sparks of fire when struck upon steel. Its name is from the Greek, signifying *fire stone.*

Pyritiferous, containing pyrites.

Quartz, a simple mineral, consisting of pure silex. It crystallizes commonly in the form of a six sided prism, with six sided pyramids at the terminations of the crystals. Its primitive form is a rhomboid.

Sandstone, a rock composed of grains of sand cemented together, and often containing layers of mica. Its colors are red, grey, green, or white. When red, it is colored by per-oxide of iron.

Scoriæ, volcanic cinders.

Secondary; this group of rocks rests upon the transition series, and is characterized by a great number of fossil remains of land plants, marine shells, and animals, for a list of which see De la Beche's Manual of Geology, 1 v. 8vo. The great beds of bituminous coal are found in this class of rocks. The secondary rocks were set apart before the discovery of the transition, and since they formed the second group, took this name.

Shaft, a perpendicular pit excavated in mining.

Shale, is a kind of slate clay, impregnated with carbon or with bitumen, the former in case it occurs with anthracite, the latter when it occurs with bituminous coal. It is generally filled with impressions of ferns and other plants of the coal formation. Shale generally occurs in immediate contact with beds of coal. Etym. German, *schalen*, to peel or split.

SIENITE, a rock like granite, from which it differs by having hornblende in the place of mica.

SPECULAR IRON, ores of iron which shine like a mirror. They are composed chiefly of per-oxide of iron, which is crystallized. Etym. *speculum*, a mirror.

STRATA, layers of rock which have evidently been formed by the gradual deposition of particles suspended in water. Stratified rocks were deposited horizontally, and have since tilted up so as to form an angle with the horizon. [See Dip.] Stratified rocks when in contact with rocks of igneous origin, become strangely altered, and often are rendered highly crystalline. It is thus supposed that gneiss, mica-slate, and talcose-slate, are *metamorphic rocks*, or have been changed by heat and rendered crystalline.

STRATUM, STRATA, when the rocks are in regular layers like the leaves of a book, piled one upon another, each leaf representing a stratum. Etym. *stratum*, part. of a Latin verb, signifying to strew or spread out.

SULPHATE, means the combination of sulphuric acid with a base of metallic oxide.

SULPHURET, signifies the combination of sulphur with a metallic substance.

SHAGNEOUS PLANTS, mossy.

SPONGIOLES, or SPONGELETS, tips of the root fibres, which absorb fluids from the soil.

TALC, a mineral in laminæ like mica, but flexible, non-elastic, and soapy to the feel. It is composed of silex, magnesia, and water. It is commonly green, or greenish white.

TERTIARY, this class reposes on the secondary series, and the name originally signified the third order. This formation is remarkable for the great number of fossil shells which it contains. The tertiary group consists of various limestones, clay, and sand, arranged in regular strata. Lyell divides the tertiary formation into three groups—1st, Eocene; 2d, Miocene; and 3d, Pliocene; these divisions depending upon the relative proportions of recent shells found in the strata. Eocene, means the dawn or beginning of recent species. Miocene, signifies a minority of recent species. Pliocene, a majority of recent species; these names being derived from the Greek.

TITANIUM, a metallic substance very difficult to reduce from its ores. [See books on Mineralogy.]

TRANSITION, rocks which are supposed to have been formed while the world was undergoing a transition from an uninhabitable to a habitable state. This class of rocks repose upon the primary, and are characterized by organic remains of animals and vegetables. The fossil trilobites are regarded as their characteristic fossils. Terebratulæ, producti, and various other shells, abound in this series. Various marine plants and ferns are also found in this formation.

TUNGSTEN, is a metallic substance. Its oxides combine with alkalies, hence they have the properties of acids. [See books on Chemistry.]

TREMOLITE, a simple mineral, generally occurring in flattened crystals, arranged in radiated masses.

VEINS, are distinguished by their *cutting across* the strata, and are not coincident with their direction. Veins are generally more irregular than beds.

ZEOLITE, a genus of minerals, which have the property of boiling or swelling in a peculiar manner when melted.

ERRATA.

On page 179, 5th line from top, for "corallnes," read corallines.
On page 238, for "athracite," read anthracite.
On page 236, bottom line, for "73.438," read 74.687.
On page 259, 15th line from top, for "I put on nine," read I put on none.

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